The "How" Book For Contractors

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Phone 296

The "How" Book For Contractors

A Common Sense Reference Work for the Practical Man

PRIVATE EDITION

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HARVARD, ILLINOIS

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Table of Contents

PART I

HOW TO FIGURE

Designing and Construction Data fro "Radford's Estimating and Contracting"*

ROOF PITCHES

The term "pitch" as applied to slanting roofs means t value found by dividing the height of the ridge or highest poi of the roof above the side walls by the distance between the si walls. For instance, if the height of the ridge above the t plate is 6 feet and the distance between the top plates is 24 fe then the pitch is ¼.

Table 1 shows the angles made by the sloping rafters wi the horizontal, expressed in degrees for different pitches of ro

TABLE I.

Angle Between Rafter and Horizontal for Various Roof Pitches

Pitch of Roof	Angle Corresponding	Pitch of Roof	Angle Corresponding	Pitch of Roof	Angle Correspondi
1-24	4° 46′	3-8	36° 53′	17-24	54° 47′
1-12	9° 28′	5-12	39° 48′	3-4	56° 19′
1-8	14° 2′	11-24	42° 31′	19-24	57° 44′
1-6	18° 26′	1-2	45° 0′	5-6	59° 2′
5-24	22° 37′	13-24	47° 18′	7-8	60° 17′
1-4	26° 34′	7-12	49° 24′	11-12	61° 23′
7-24	30° 15′	5-8	51° 21′	23-24	62° 27′
1-3	33° 41′	2-3	53° 8′	1	63° 26′

Rule for Proportions of Gambrel Roof

As a guide to use in determining the lengths of rafters gambrel roof construction, the following diagram will be service:

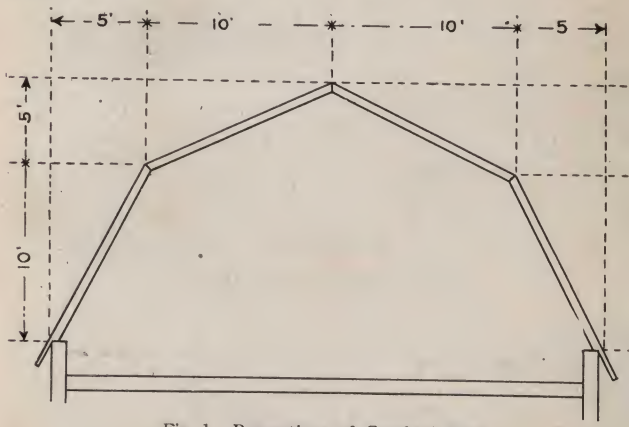


Fig. 1.—Proportions of Gambrel Roof

The rule followed in Fig. 1 is to take ⅛ of width of span fo the base and ⅓ of same for the rise; this is the first or lower pitch Reversing these parts, will give the upper pitch. For instance in the roof shown, which is 30 feet wide, the proportions woul be 5 and 10, and 10 and 5 respectively.

*Published by the Radford Architectural Company, Chicago, Ill.

TABLE II.

Weights of Roofing Materials

	Weight in Pounds Per Square Foot
Asphalt on felt, without sheathing	2
Ceiling, ordinary lath and plaster	6 to 8
Ceiling, stamped steel	2
Ceiling, wood, ¾ in.	2½
Composition, 3-ply	1
Concrete, per 1 inch thickness of slab	13
Copper, sheet	1 to 1½
Felt, roofing, 2 layers	½
Gravel and felt, without sheathing	8 to 10
Iron, corrugated, No. 18	2½
Iron, corrugated, No. 20	2
Iron, corrugated, No. 24	1¼
Iron, flat, galvanized	1 to 3½
Lead, sheet	4 to 8
Sheathing, hemlock, 1 in. thick	2
Sheathing, spruce, 1 in. thick	2
Sheathing, yellow pine, 1 in. thick	4
Sheathing, white pine, 1 in. thich	3
Shingles, wood, cedar	1½
Shingles, cypress	2½
Shingles, metal, tin, painted	1
Shingles, metal, copper	1½
Skylight, glass, $\frac{3}{16}$ to ½ in. with frames	4 to 10
Slate, $\frac{3}{16}$ to ¼ in.	7 to 9
Slate, dimishing courses	12
Steel, standing seam	1
Tar and gravel, 4-ply	5½
Tar and gravel, 5-ply	6
Tiles, corrugated	8 to 10
Tiles, flat	15 to 20
Tiles, Ludowici	8
Tiles, on concrete slabs	30 to 35
Tiles, pan	10
Tin, on felt	1
Tin, without sheathing	½ to 1
Zinc, sheet	1 to 2

TABLE III.

Average Weight of Timber

Ash	42 lbs. per cu. ft.
Chestnut	41 " " " "
Hemlock	25 " " " "
Hickory	53 " " " "
Maple	49 " " " "
Oak	32 to 48 " " " "
Pine, Norway	36 " " " "
Pine, white	25 " " " "
Pine, yellow, Northern	34 " " " "
Pine, yellow, Southern	45 " " " "
Spruce	25 " " " "

To find the weight of a board foot of these materials, divide the weight given by 12.

TO DETERMINE NUMBER OF FEET BOARD MEASURE IN TIMBER

A board foot is a piece of timber 12 inches long, 12 inches wide and 1 inch thick. Thus a block of timber 12 inches square on the end and 1 foot, or 12 inches, long, would contain 12 board feet. A simple rule for finding the number of board feet in a piece of timber is to multiply the end dimensions together, divide this product by 12 and multiply this answer by the length of the piece in feet.

Thus, a 2-inch by 12-inch joist, 16 feet long would contains $\frac{2 \times 12}{12} \times 16 = 32$ board feet.

Table IV gives the number of board feet in 1 foot of length of common sizes of lumber.

TABLE IV.

Board Measure Per Lineal Foot for Different Sizes of Timber

End Size in Inches	Feet Board Measure	End Size in Inches	Feet Board Measure	End Size in Inches	Feet Board Measure
1 x 2	.17	1¼ x 10	1.04	3 x 10	2.50
1 x 3	.25	1¼ x 12	1.25	3 x 12	3.00
1 x 4	.33			3 x 14	3.50
1 x 5	.42	1½ x 2	.25		
1 x 6	.50	1½ x 3	.37	4 x 4	1.33
1 x 8	.67	1½ x 4	.50	4 x 6	2.00
1 x 10	.83	1½ x 5	.62		
1 x 12	1.00	1½ x 6	.75	6 x 6	3.00
1 x 14	1.17	1½ x 8	1.00	6 x 8	4.00
1 x 16	1.33	1½ x 10	1.25		
1 x 18	1.50	1½ x 12	1.50	8 x 8	5.33
1 x 20	1.67			8 x 10	6.66
		2 x 4	.67	8 x 12	8.00
1¼ x 2	.21	2 x 6	1.00		
1¼ x 3	.31	2 x 8	1.33	10 x 10	8.33
1¼ x 4	.42	2 x 10	1.67	10 x 12	10.00
1¼ x 5	.52	2 x 12	2.00		
1¼ x 6	.62	2 x 14	2.33	12 x 12	12.00
1¼ x 8	.83				
		3 x 4	1.00	14 x 14	16.33
		3 x 6	1.50		
		3 x 8	2.00	16 x 16	21.33

Lumber of any given width may be calculated from the table by adding together the board measure in two other sizes of the same thickness of material. For instance, a 2 x 16-inch timber will contain twice as many board feet as a 2 x 8-inch piece, or as much as a 2 x 12-inch and a 2 x 4-inch taken together.

ORDINARY LUMBER WASTE

In the use of ordinary lumber on walls, floors, ceilings, etc., the following percentages should be added to the actual measurement of the surface to be covered, in order to allow for lapping, matching, etc.:

Battens, 1 x 4, placed 6 inches on centers, only 2-3 of surface measure is needed.

Battens, 1 x 6, placed 8 inches on centers, only ¾ of surface measure is needed.

Ceiling will be same as flooring given below.

Flooring, 3-inch matched.....50%
Flooring, 4-inch.....33%
Flooring, 6-inch.....20%

ORDINARY LUMBER WASTE—Continued

Papers and felts are usually listed for enough less than the roll actually contains to allow for lapping.

Sheathing, common, laid horizontally on walls without openings	10%
Sheathing, common, laid horizontally on roofs without openings	10%
Sheathing, common, laid horizontally on dwellings with usual openings	Nothing
Sheathing, common, laid diagonally on dwellings with usual openings	17%
Sheathing, tight, 6 inches, laid horizontally	20%
Sheathing, tight, 8 inches, laid horizontally	15%
Sheathing, tight, 10 inches, laid horizontally	12%
Sheathing, tight, 6 inches, laid diagonally	25%
Sheathing, tight, 8 inches, laid diagonally	17%
Sheathing, tight, 10 inches, laid diagonally	12%
Siding, drop	20%
Siding, lap, 4 inches to weather	50%
Siding, lap, 4½ inches to weather	33%

To estimate the quantity of sheathing or of shiplap approximately, calculate the exact surface to be covered, deducting openings; then add the following percentages:

	Sheathing	Shiplap
For floors	1-7 or 15%	1-6 or 17%
For side walls	1-6 or 17%	1-5 or 20%
For roofs	1-5 or 20%	1-4 or 25%

NUMBER OF BOARD FEET IN LOGS

The hand-book gotten out by the Forest Service on log rules, shows forty-five different methods for measuring logs, each of which differs in some respect from the others. In the southern and central sections of the country the rule most generally followed is the Scribner-Doyle, which is based on the number of square-edged inch boards of standard width a log will make, and in scaling by this rule measurement is taken at the small end of the log inside of the bark. Or if it is a longer log to be cut in two before sawing, the measurement of both ends is taken and the average diameter of the two makes the scale measurement for the butt log.

There is a rule known as the Three-quarter Rule, said to be used in Maine, New Hampshire and Massachusetts, the formula on which it is based being as follows: Deduct one-quarter the diameter at the small end of the log inside of the bark for saw kerf and slabs, square the remainder, multiply by the length of the log, and divide this last product by 12 for the contents of the log in board feet.

There is another rule known as the Orange River Rule which is used in Texas and based on the following: Multiply the square of the diameter of the small end of the log inside of the bark by the length of the log and divide the product by 30. The result is the contents in board feet.

All of these rules are based on the measurements taken at the small end of the log inside the bark. By keeping this in mind and getting a copy of the table of rules followed by the purchaser of the timber, the amount of timber may be estimated easily before it is hauled.

NUMBER OF BOARD FEET IN LOGS—Continued

Another rule is known as the New Hampshire rule. This rule is based on an imaginary cubic foot equal to about 1 4-10 times the standard cubic foot. The statutes of New Hampshire, 1910, give the law on this rule as follows:

"All round timber, the quantity of which is estimated by the thousand, shall be measured according to the following rules: A stick of timber 16 inches in diameter and 12 inches long shall constitute one cubic foot, and the same ratio shall apply to any other size and quantity. Each cubic foot shall constitute ten feet of a thousand board feet."

In the practical use of this rule it is customary to consider 115 cubic feet equivalent to 1,000 feet board measure, instead of 100 cubic feet, according to the wording of the statute. In this case the diameter is taken at the middle of the log inside the bark. If the diameter is measured at the small end of the log, 106 cubic feet are allowed for 1,000 board feet. The New Hampshire Rule is also called the Blodgett Rule.

SHRINKAGE OF LUMBER

Timber shrinks but very little lengthwise of the grain when drying, but crosswise the shrinkage may be quite a considerable amount. This shrinkage in width varies considerably in different kinds of timber. The soft woods such as pine, spruce or cypress shrink evenly with but little cracking, but the hardwoods, such as oak and hickory, are often subject to injury.

Table V gives the approximate shrinkage of lumber when drying in the open air.

TABLE V.
Approximate Shrinkage of Timber Per Foot of Width in Drying

Kind of Wood	Shrinkage in Inches Per Foot of Width	Kind of Wood	Shrinkage in Inches Per Foot of Width
Ash	.60	Horse Chestnut	.72
Basswood	.72	Locust	.72
Beech	.60	Maple	.60
Birch	.72	Oak	1.20
Box Elder	.48	Pine, Hard	.48
Cedar	.36	Pine, Soft	.36
Cherry	.60	Poplar	.60
Chestnut	.72	Spruce	.36
Cypress	.36	Sycamore	.60
Elm	.60	Tamarack	.48
Hickory	1.20	Walnut	.60
Honey Locust	.48		

SNOW AND WIND LOADS ON ROOFS

The following snow and wind loads in pounds per square foot of area will be of service in estimating roof loads to be provided for.

SNOW LOADS

For southern states and Pacific Coast an allowance of 5 pounds per square foot of roof surface for all pitches under ½. In the central states an allowance of 5 pounds for ½ pitch; 10 pounds for 1-3 pitch; 18 pounds for ¼ pitch; 20 pounds for 1-5 pitch, and 30 pounds for all pitches less than 1-5 will be sufficient. For localities such as the New England states and Rocky Mountain states, an allowance of 10 pounds for ½ pitch; 12 pounds for 1-3 pitch; 22 pounds for ¼ pitch; 28 pounds for 1-5 pitch; and 35 pounds for pitches less than 1-5 are in common use. For localities where heavy snowfall may occur, it is well to add about 5 pounds per square foot to the values given for the New England states.

WIND LOADS

The normal component of the wind pressure is added to other loads which act upon a roof. For ½ pitch, the normal wind load is usually taken as 27 pounds per square foot of roof; for 1-3 pitch, 22 pounds; for ¼ pitch, 18 pounds; for 1-5 pitch, 15 pounds, and for 1-6 pitch, 13 pounds.

No roof should be designed for a total dead, snow, and wind load of less than 40 pounds per square foot of roof surface, except flat roofs in warm climates.

BEAM FORMULA

Formula for strength of beams freely supported at ends:

$$p \frac{I}{e} = M$$

where p is the unit bending strength of the material in pounds per square inch (see Table VI) I is the moment of inertia of the beam cross-section; e is the distance from the center of gravity of the beam section to the outer fibers at top or bottom (see Table IX for values of I and e), and M is the value of the greatest bending moment as given in Fig. 3. All of these quantities should be expressed in pound and inch units.

This formula may be used to find the size of a beam necessary for a given load; to find the load which may be carried by a beam of a given size; or to find the degree of safety which exists in a beam of a given size which is carrying a given load.

TABLE VI.

Average Safe Working Unit Stresses in Bending for Timber

	Pounds per Square Inch
White Oak	1,200
Southern Long Leaf or Georgia Yellow Pine	1,200
Short Leaf Yellow Pine	1,000
Norway Pine	800
Cypress	800
California Spruce	800
Chestnut	800
Douglas Fir	800
California Redwood	750
White Pine	700
Spruce	700
Eastern Fir	700
Cedar	700
Hemlock	600

ACTUAL SIZES OF LUMBER

About 95 per cent of the southern yellow pine on the market is classified and graded according to the rules of the Southern Yellow Pine Manufacturers' Association and runs from ¼ to ⅝ inch smaller in dimension than called for by its nominal size. Table VII gives the actual sizes of the various nominal sizes of yellow pine lumber as given by the above named association. Where the letters S-1-S-1-E are used it means that the lumber is surfaced or planed on one side and one edge only, while S-4-S designates that the material is surfaced on all four sides.

TABLE VII.

Table Showing Actual Sizes of Lumber Dimensions, in Inches

(Southern Yellow Pine Manufacturers' Association)

FOR S. 1 S. 1 E.

Breadth	2 in.	4 in.	6 in.	8 in.	10 in.	12 in.
Depth						
4 in.	1⅝ x 3⅝	3⅝ x 3⅝				
6 in.	1⅝ x 5⅝	3⅝ x 5⅝	5⅝ x 5⅝			
8 in.	1⅝ x 7⅝	3⅝ x 7⅝	5⅝ x 7⅝	7¼ x 7¼		
10 in.	1⅝ x 9½	3⅝ x 9⅝	5¼ x 9¾	7¼ x 9¾	9¾ x 9¾	
12 in.	1⅝ x 11½	3⅝ x 11⅝	5¾ x 11¾	7¼ x 11¾	9¼ x 11¾	11¼ x 11¼
	FOR S. 4 S.					
4 in.	1½ x 3½	3½ x 3½				
6 in.	1½ x 5½	3½ x 5½	5½ x 5½			
8 in.	1½ x 7½	3½ x 7½	5½ x 7½	7½ x 7½		
10 in.	1½ x 9½	3½ x 9½	5½ x 9½	7½ x 9½	9½ x 9½	
12 in.	1½ x 11½	3½ x 11½	5½ x 11½	7½ x 11½	9½ x 11½	11½ x 11½

If calculations for safe loads on beams have been made by using the full and rated size of timber, the load obtained for full-size cross-section should be multiplied by the factor corresponding to that size of section given in Table VIII.

For instance, the safe load for a 2-inch by 12-inch yellow pine joist 10 feet long is 3,200 pounds when the joist is taken as full 2-inches by 12-inches. From Table VII we see that the actual size of this joist is only 1⅝ by 11½ inches, therefore the true load would be determined by multiplying 3,200 pounds by 75-100 as given in Table VIII. On this basis, the safe allowable load would be 2,400.

TABLE VIII.

Factors for Reducing Nominal Loads to Real Safe Loads

FOR S. 1 S. 1 E.

Breadth	2 in.	4 in.	6 in.	8 in.	10 in.	12 in.
Depth						
4 in.	67/100	74/100				
6 in.	71/100	8/10	82/100			
8 in.	71/100	82/100	9/10	9/10		
10 in.	73/100	84/100	9/10	92/100	93/100	
12 in.	75/100	85/100	92/100	93/100	94/100	94/100

(Continued on next page)

TABLE VIII—Continued

FOR S. 4 S.

4 in.	$\frac{57}{100}$	$\frac{67}{100}$				
6 in.	$\frac{63}{100}$	$\frac{74}{100}$	$\frac{77}{100}$			
8 in.	$\frac{64}{100}$	$\frac{77}{100}$	$\frac{81}{100}$	$\frac{82}{100}$		
10 in.	$\frac{66}{100}$	$\frac{79}{100}$	$\frac{83}{100}$	$\frac{85}{100}$	$\frac{86}{100}$	
12 in.	$\frac{67}{100}$	$\frac{8}{10}$	$\frac{84}{100}$	$\frac{86}{100}$	$\frac{87}{100}$	$\frac{88}{100}$

Fig. 2—Some of the Common Shapes of Cross Section Used in Construction

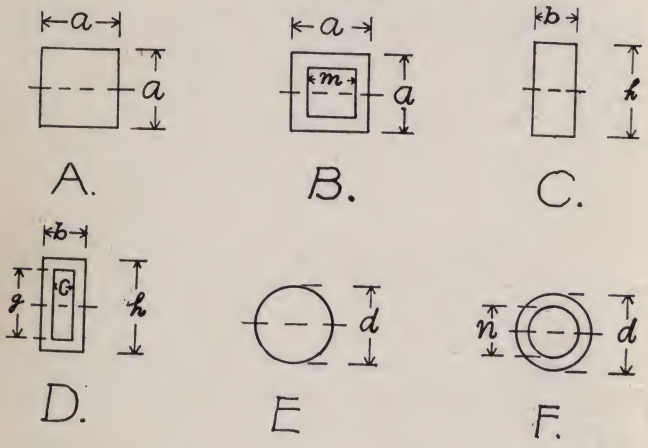


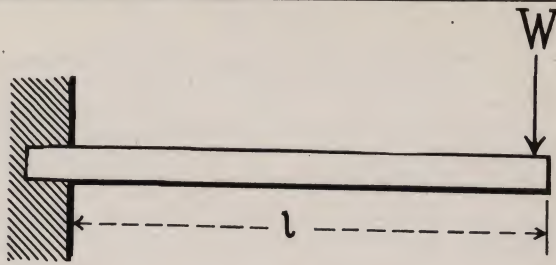
TABLE IX.

Values of I, e, and Areas of Cross-section for Use With Common Structural Shapes Shown in Fig. 2

	A	B	C	D	E	F
I	$\frac{a^4}{12}$	$\frac{a^4-m^4}{12}$	$\frac{bh^3}{12}$	$\frac{bh^3-cg^3}{12}$	$\frac{d^4}{20}$	$\frac{d^4-n^4}{20}$
e	$\frac{a}{2}$	$\frac{a}{2}$	$\frac{h}{2}$	$\frac{h}{2}$	$\frac{d}{2}$	$\frac{d}{2}$
Area of Cross-Section	a^2	a^2-m^2	bh	$bh-cg$	$\frac{11}{14}d^2$	$\frac{11}{14}(d^2-n^2$

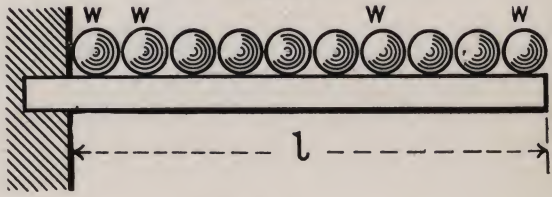
VALUES OF MAXIMUM BENDING MOMENT

Fig. 3 gives the values of M, the maximum bending moment, for four common cases of beams and cantilevers. In each case W is the total load on the member in pounds; B is the weight of the beam itself in pounds; W is the load per inch of length of beam; and a, b, and l are lengths as shown in inches.



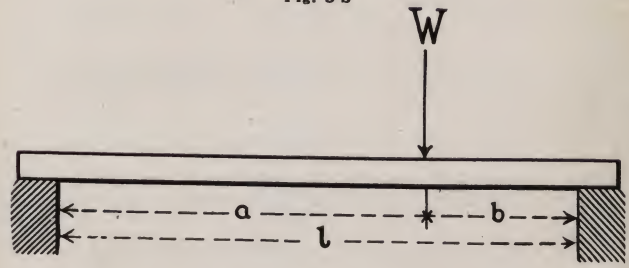
$$M = Wl + \frac{Bl}{2}$$

Fig. 3 a



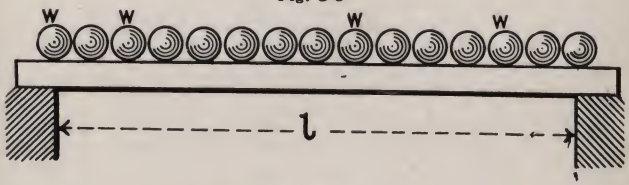
$$M = \frac{(W+B)l}{2}$$

Fig. 3 b



$$M = \frac{a(2Wb + Bl - Ba)}{2l}$$

Fig. 3 c



$$M = \frac{(W+B)l}{8}$$

Fig. 3 d

Fig. 3—Values of Bending Moments

TABLE X.

Table For Finding the Safe Load that a Rectangular Horizontal Beam Will Support*

To find the safe load for any horizontal rectangular beam of any size given in the table below and of any kind of wood listed in the adjacent table, and loaded with an evenly distributed load, multiply together the figure given in the lower table for the required size of beam, the breadth of the beam and value given for "A" in the adjacent table for the kind of wood to be used —for concentrated loads divide the result by two.

KIND OF WOOD	A
Douglas Fir and Long Leaf Yellow Pine	13
Short Leaf Yellow Pine	10
Oak	12
Norway Pine and Spruce	8
White Pine	8
Hemlock	6

DEPTH OF BEAM IN INCHES

Span in Ft.	4	5	6	7	8	9	10	11	12	13	14	15	16
4	44.4	69.4	100.0	136.1	177.8	225.0	277.8	336.1	400.0	469.4	544.4	277.8	316.0
5	35.6	55.6	80.0	108.9	142.2	180.0	222.2	268.9	320.0	375.6	435.6	250.0	284.4
6	29.6	46.3	66.7	90.7	118.5	150.0	185.2	224.1	266.7	313.0	363.0	227.3	258.6
7	25.4	39.7	57.1	77.8	101.6	128.6	158.7	192.1	228.6	268.3	311.1	208.3	237.0
8	22.2	34.7	50.0	68.1	88.9	112.5	138.9	168.1	200.0	234.7	272.2	192.3	218.8
9	19.8	30.9	44.4	60.5	79.0	100.0	123.5	149.4	177.8	208.6	242.0	178.6	203.2
10	17.8	27.8	40.0	54.4	71.1	90.0	111.1	134.4	160.0	187.8	217.8	166.7	189.6
11	16.2	25.3	36.4	49.5	64.6	81.7	101.0	122.2	145.5	170.7	198.0	156.3	177.8
12	14.8	23.1	33.3	45.4	59.3	75.0	92.6	112.0	133.3	156.5	181.5	147.1	167.3
13	13.7	21.4	30.8	41.9	54.7	69.2	85.5	103.4	123.1	144.4	167.5	138.9	158.0
14	12.7	19.8	28.6	38.9	50.8	64.3	79.4	96.0	114.3	134.1	155.6	131.6	149.7
15	11.9	18.5	26.7	36.3	47.4	60.0	74.1	89.6	106.7	125.2	145.2	125.0	142.2
16	11.1	17.4	25.0	34.0	44.4	56.3	69.4	84.0	100.0	117.4	136.1	119.0	135.4
17	10.5	16.3	23.5	32.0	41.8	52.9	65.4	79.1	94.1	110.5	128.1	113.6	129.3
18	9.9	15.4	22.2	30.2	39.5	50.0	61.7	74.7	88.9	104.3	121.0	108.7	123.7
19	9.4	14.6	21.1	28.7	37.4	47.4	58.5	70.8	84.2	98.8	114.6	104.2	118.5
20	8.9	13.9	20.0	27.2	35.6	45.0	55.6	67.2	80.0	93.9	108.9	100.0	113.8
21	8.5	13.2	19.0	25.9	33.9	42.9	52.9	64.0	76.2	89.4	103.7	96.2	109.4
22	8.1	12.6	18.2	24.7	32.3	40.9	50.5	61.1	72.7	85.4	99.0	92.6	105.3
23	7.7	12.1	17.4	23.7	30.9	39.1	48.3	58.5	69.6	81.6	94.7	89.3	111.6
24		11.6	16.2	22.7	29.6	37.5	46.3	56.0	66.7	78.2	90.7	86.2	98.1
25		11.1	16.0	21.8	28.4	36.0	44.4	53.5	64.0	75.1	87.1	83.3	94.8
26		10.7	15.4	20.9	27.4	34.6	42.7	51.7	61.5	72.2	83.8	80.6	91.8
27		10.3	14.8	20.2	26.3	33.3	41.2	49.8	59.3	69.5	80.7	78.1	88.9
28		9.9	14.3	19.4	25.4	32.1	39.7	48.0	57.1	67.1	77.8	75.8	86.2
29			13.8	18.8	24.5	31.0	38.3	46.4	55.2	64.8	75.1	73.5	83.7
30			13.3	18.1	23.7	30.0	37.0	44.8	53.3	62.6	72.6	71.4	81.3

Example

Suppose it is required to find the safe evenly distributed load for a 2x14 inch beam, 18 feet long, of short leaf yellow pine—we first find the figure given for the unit strength of a beam 14 inches deep and 18 feet long. We find this number to be 121; the breadth of our beam is 2 inches; multiplying the two numbers together we have 242. The value of A for short leaf yellow pine is 10. We now only have to multiply 242 by 10 and we have the safe, evenly distributed load in pounds for our beam, which is 2,420 pounds. Now to find the safe concentrated load for the same beam, divide this number by two and we will then find that our beam will support a safe concentrated load of 1,210 pounds.

*Furnished by Hunt, Helm, Ferris & Company.

TABLE XI.

Final Crushing Strength of Building Materials in Pounds Per Square Inch

(Loads on Timber Applied in Direction of Grain)

MATERIAL	Short Column Under 12 Times Least Dimension	Columns Over 12 Times Least Dimension
White Oak	5,000	7,000
White Pine	3,500	5,500
Long Leaf or Georgia Yellow Pine	5,000	7,000
Douglas Fir	4,500	5,700
Short Leaf Yellow Pine	4,500	6,000
Norway Pine	4,000	5,000
Spruce and Eastern Fir	4,000	6,000
Hemlock	4,000	
Cypress	4,000	5,000
Cedar	3,500	5,500
Chestnut	4,000	
California Redwood	4,000	
California Spruce	4,000	
Cast Iron	80,000	70,000
Mild Steel	60,000	50,000
Concrete (1:2:4 mixture)	2,000	

CAST IRON COLUMNS

Table XII contains values for the safe load in pounds per square inch of cross-section of hollow round and rectangular cast iron columns as recommended by Kidders Architect's Pocket Book. These unit loads are based on a factor of safety of 8. To find the total central load which may be carried by a column of a given size, multiply the area of the cross-section of the column by the unit load corresponding and taken from the table. The value "*d*" referred to in the table is the least exterior dimension of the column, in inches.

TABLE XII.

Safe Unit Loads for Cast Iron Columns

Length in Inches Divided by Least Value of d.	Round	Rectangular	Length in Inches Divided by Least Value of d.	Round	Rectangular
8	9,259	9,433	23	6,020	6,684
9	9,082	9,293	24	5,814	6,494
10	8,888	9,140	25	5,614	6,305
11	8,688	8,983	26	5,420	6,120
12	8,475	8,811	27	5,233	5,940
13	8,257	8,635	28	5,050	5,764
14	8,032	8,446	29	4,875	5,592
15	7,806	8,257	30	4,706	5,424
16	7,576	8,064	31	4,543	5,260
17	7,347	7,867	32	4,386	5,102
18	7,117	7,670	33	4,235	4,947
19	6,892	7,468	34	4,090	4,797
20	6,666	7,272	35	3,951	4,655
21	6,447	7,076	36	3,817	4,515
22	6,230	6,877			

TABLE XIII.

Areas of Circles of Different Diameters

Diameter	Area	Diameter	Area	Diameter	Area	Diameter	Area
1/8	0.0123	10	78.54	30	706.86	65	3318.3
1/4	0.0491	10½	86.59	31	754.76	66	3421.2
3/8	0.1104	11	95.03	32	804.24	67	3525.6
1/2	0.1963	11½	103.86	33	855.30	68	3631.6
5/8	0.3068	12	113.09	34	907.92	69	3739.2
3/4	0.4418	12½	122.71	35	962.11	70	3848.4
7/8	0.6013	13	132.73	36	1017.8	71	3959.2
1	0.7854	13½	143.13	37	1075.2	72	4071.5
1 1/8	0.9940	14	153.93	38	1134.1	73	4185.4
1 1/4	1.227	14½	165.13	39	1194.5	74	4300.8
1 3/8	1.484	15	176.71	40	1256.6	75	4417.8
1 1/2	1.767	15½	188.69	41	1320.2	76	4536.4
1 5/8	2.073	16	201.06	42	1385.4	77	4656.6
1 3/4	2.405	16½	213.82	43	1452.2	78	4778.3
1 7/8	2.761	17	226.98	44	1520.5	79	4901.6
2	3.141	17½	240.52	45	1590.4	80	5026.5
2 1/4	3.976	18	254.46	46	1661.9	81	5153.0
2 1/2	4.908	18½	268.80	47	1734.9	82	5281.0
2 3/4	5.939	19	283.52	48	1809.5	83	5410.6
3	7.068	19½	298.64	49	1885.7	84	5541.7
3 1/4	8.295	20	314.16	50	1963.5	85	5674.5
3 1/2	9.621	20½	330.06	51	2042.8	86	5808.8
3 3/4	11.044	21	346.36	52	2123.7	87	5944.6
4	12.566	21½	363.05	53	2206.1	88	6082.1
4½	15.904	22	380.13	54	2290.2	89	6221.1
5	19.635	22½	397.60	55	2375.8	90	6361.7
5½	23.758	23	415.47	56	2463.0	91	6503.9
6	28.274	23½	433.73	57	2551.7	92	6647.6
6½	33.183	24	452.39	58	2642.0	93	6792.9
7	38.484	24½	471.43	59	2733.9	94	6939.8
7½	44.178	25	490.87	60	2827.4	95	7088.2
8	50.265	26	530.93	61	2922.4	96	7238.2
8½	56.745	27	572.55	62	3019.0	97	7389.8
9	63.617	28	615.75	63	3117.2	98	7542.9
9½	70.882	29	660.52	64	3216.9	99	7697.7

Areas of hollow circular sections may be found by subtracting the area of a circle whose diameter is equal to the inside diameter of the hollow section, from the area of a circle of diameter equal to the outside diameter of the hollow section.

SAFE LOADS FOR COLUMNS*

To find the proper size of post (see Table XV, page 17) to support the second floor or hay loft of a barn, the total load per square foot of floor area that is to be supported by the post shall be estimated at 80 pounds for structures up to and including a medium size barn and 100 pounds for large barns, and heavily loaded hay lofts and grain rooms.

TABLE XIV.

SAFE LOADS IN TONS FOR STEEL PIPE COLUMNS*

The safe loads below are 1/6 for wood and ¼ for steel of the ultimate capacity of post.

Diameter	Length in Feet					
	7	8	9	10	12	14
2	3.97	3.69	3.47			
3	9.60	9.14	8.75	8.35	7.52	
4	15.05	14.45	14.11	13.65	12.72	11.78
5	19.78	18.76	18.76	12.26	17.51	16.26
6	27.27	26.06	26.06	25.06	24.39	23.32

*Furnished by Hunt, Helm, Ferris & Company.

TABLE XV.

TABLE OF SAFE LOADS FOR COLUMNS*

The Safe Loads Below Are 1-6 for Wood and 1-4 for Steel of the Ultimate Capacity of Post. Table of Safe Loads in Tons for Wood Columns—Round and Square

Kind of Wood	Height of Post in Feet	DIMENSIONS OF CROSS SECTION										Height of Post in Feet	Kind of Wood
		8-inch Diam. Round	6-inch Diam. Round	5-inch Diam. Round	10-inch x 10-inch	8 in. x 10 in.	8 in. x 8 in.	6 in. x 8 in.	6 in. x 6 in.	4 in. x 6 in.	4 in. x 4 in.		
Hemlock	7	10.91	5.84	3.88	22.40	17.40	13.92	9.91	7.43	4.42	2.95	7	Hemlock
	8	10.66	5.65	3.73	22.00	17.00	13.60	9.60	7.20	4.20	2.80	8	
	9	10.43	5.48	3.58	21.62	16.64	13.31	9.31	6.98	3.97	2.65	9	
	10	10.20	5.30	3.44	21.20	16.20	13.00	9.00	6.75	3.75	2.50	10	
	12	9.75	4.93	3.14	20.50	15.50	12.38	8.40	6.28			12	
	14	9.60	4.76		20.10	15.30	12.18	8.10	6.08			14	
White Oak	7	19.64	10.50	6.98	40.30	31.30	25.05	17.85	13.38	9.97	5.30	7	White Oak
	8	19.15	10.15	6.71	39.60	30.60	24.50	17.26	12.96	7.56	5.03	8	
	9	18.80	9.85	6.44	38.90	29.95	24.00	16.75	12.57	7.14	4.76	9	
	10	18.35	9.54	6.18	38.20	29.15	23.40	16.20	12.14	6.75	4.49	10	
	12	17.55	8.87	5.65	36.90	27.90	22.25	15.10	11.30			12	
	14	17.25	8.56		36.20	27.50	21.95	14.58	10.22			14	
Georgia Yellow Pine (Long Leaf)	7	24.00	12.82	8.55	49.25	38.30	30.60	21.80	16.35	9.74	6.49	7	Georgia Yellow Pine (Long Leaf)
	8	23.40	12.42	8.81	48.40	37.40	29.90	21.10	15.82	9.24	6.16	8	
	9	23.00	12.02	7.87	47.60	37.60	29.30	20.28	15.36	8.74	5.83	9	
	10	22.45	11.65	7.56	46.60	35.60	28.60	19.80	14.83	8.24	5.50	10	
	12	21.45	10.82	6.90	45.00	34.10	27.20	18.50	13.80			12	
	14	21.10	10.46		44.20	33.60	26.75	17.80	12.15			14	
Oregon Yellow Pine (Short Leaf)	7	17.45	9.34	6.21	35.82	27.80	22.25	15.85	11.90	7.10	4.72	7	Oregon Yellow Pine (Short Leaf)
	8	17.05	9.03	5.97	35.20	27.20	21.75	15.35	11.52	6.72	4.48	8	
	9	16.70	8.76	5.73	34.60	26.65	21.30	14.90	11.17	6.35	4.24	9	
	10	16.30	8.47	5.50	33.90	25.90	20.80	14.38	10.80	5.99	4.00	10	
	12	15.60	7.88	5.05	32.80	25.80	19.75	13.40	10.05			12	
	14	15.35	7.60		32.15	24.45	19.45	12.95	9.23			14	
Spruce, Norway and White Pine	7	15.26	8.17	5.43	31.38	24.35	19.50	13.88	10.40	6.20	4.13	7	Spruce, Norway and White Pine
	8	14.90	7.91	5.24	30.80	23.80	19.03	13.43	10.08	5.88	3.92	8	
	9	14.62	7.67	5.02	30.25	23.28	18.65	13.05	9.78	5.56	3.71	9	
	10	14.28	7.42	4.82	29.65	22.62	18.20	12.58	9.45	5.25	3.50	10	
	12	13.65	6.88	4.40	28.70	21.70	17.30	11.73	8.80			12	
	14	13.40	6.66		28.15	21.40	17.00	11.32	8.50			14	

*Furnished by Hunt, Helm, Ferris & Company.

ESTIMATING MATERIAL FOR BUILDINGS

In estimating material for buildings it is often desirable to have some easy, quick and reliable methods that will enable the contractor to arrive at a close, approximate cost without the necessity of going into all the details and making out lumber bills. As nearly all lumber is sold by board measure, it is apparent that an easy system of reducing lineal feet of different size timbers to board measure is one thing wanted. This is the case with sills, girders and beams. The lineal feet of such timbers in many plans can be determined in a few minutes; then if these quantities can quickly be reduced to board measure, the cost can be figured without difficulty. Again, if the number of feet board measure for various kinds of framing is known, then the estimate of the cost of material for such work is quickly reached. For assisting in estimating the cost of material without making out a bill in detail, the following will be of service:

TABLE XVI.

Number of Feet, Board Measure, Per Lineal Foot in Sills, Girders and Beams

4 in. x 6 in.	2 feet per lineal foot
6 in. x 6 in.	3 feet per lineal foot
6 in. x 8 in.	4 feet per lineal foot
8 in. x 8 in.	5⅓ feet per lineal foot
8 in. x 10 in.	6⅔ feet per lineal foot
10 in. x 10 in.	8⅓ feet per lineal foot
10 in. x 12 in.	10 feet per lineal foot
12 in. x 12 in.	12 feet per lineal foot

TABLE XVII.

Number of Feet, Board Measure, in a Square of Framing

Partitions, Including Plates

2 in. x 4 in. partitions set 16 inches O. C.	80 feet
2 in. x 4 in. partitions set 20 inches O. C.	67 feet
2 in. x 4 in. partitions set 24 inches O. C.	60 feet
2 in. x 6 in. partitions set 16 inches O. C.	120 feet
2 in. x 6 in. partitions set 20 inches O. C.	100 feet
2 in. x 6 in. partitions set 24 inches O. C.	90 feet

The framing of outside walls may be estimated the same as above.

Floors and Ceilings, Allowing One Joist in Every Square for Doubling

2 in. x 4 in. set 16 inches O. C.	67 feet
2 in. x 6 in. set 16 inches O. C.	100 feet
2 in. x 8 in. set 16 inches O. C.	133 feet
2 in. x 10 in. set 16 inches O. C.	167 feet
2 in. x 12 in. set 16 inches O. C.	200 feet
2 in. x 12 in. set 12 inches O. C.	240 feet
2 in. x 14 in. set 16 inches O. C.	233 feet
2 in. x 14 in. set 12 inches O. C.	280 feet

Roofs, Allowing One Extra Joist Per Square for Cutting, Etc.

2 in. x 4 in. set 16 inches O. C.	67 feet
2 in. x 4 in. set 20 inches O. C.	53 feet
2 in. x 4 in. set 24 inches O. C.	47 feet
2 in. x 6 in. set 16 inches O. C.	100 feet
2 in. x 6 in. set 20 inches O. C.	80 feet
2 in. x 6 in. set 24 inches O. C.	70 feet
2 in. x 8 in. set 16 inches O. C.	133 feet
2 in. x 8 in. set 20 inches O. C.	107 feet
2 in. x 8 in. set 24 inches O. C.	93 feet

TABLE XVIII.

Number of Feet, Board Measure, Required Per Square, Allowing for Matching, Etc.

8-inch shiplap	116 feet
10 inch shiplap	125 feet
2¼-inch face matched flooring	133 feet
3¼-inch face matched flooring	125 feet
5¼-inch face matched flooring	120 feet
3¼-inch face matched flooring	125 feet
5¼-inch face matched flooring	120 feet
6-inch beveled siding	120 feet
4-inch beveled siding	133 feet
6-inch drop siding	120 feet
8-inch novelty siding	116 feet

TABLE XIX.

Number of Shingles and Lath Required Per Square

Shingles laid 4 inches to weather	1,000 per square
Shingles laid 4½ inches to weather	900 per square
Shingles laid 5 inches to weather	800 per square
Lath	14 lath per square yard
Per 100 yards	1,400

LABOR QUANTITIES IN CARPENTRY WORK

A good workman will average the following amounts of work on ordinary buildings in an 8-hour day:

Set about 500 board feet of joists, studs or common rafters.

Put on about 400 feet of dressed and matched or shiplap sheathing.

Put on about 500 feet of common sheathing on roofs or floors.

Put on about 350 feet of common 6-inch siding.
Lay about 350 feet of 4 to 6-inch flooring.
Cut and lay 1,500 shingles.
Cut and lay 250 feet of clapboards.
Fit and hang 10 two-sash windows.
Put on about 1,000 feet of rough barn boards.
Set and fit about 8 window frames.
Fit and hang 8 ordinary doors.
Case about 5 ordinary doors, one side only.

ESTIMATING QUANTITIES OF NAILS

Table XX will give the number of wire nails in pounds for various kinds of lumber per thousand feet board measure, allowance being made for loss of covering surface due to lap or matching of material. The sizes given are as rated on the market.

If cut nails are used, add 1-3 to the number of nails as shown in the table.

Table XX is based on the use of lumber cut to an average length of 12 feet, except in the case of ⅜-inch flooring, which is based on an average length of 6 feet.

Table XXI gives the approximate length and gauge number as well as the approximate number per pound for standard steel wire nails.

NAILS REQUIRED FOR DIFFERENT KINDS OF WORK

Shingles per 1,000, require 3½ pounds of 3d or 5 pounds of 4d nails.

Lath, ordinary, per 1,000, studding spaced 12-inch centers, 10 pounds of 3d common wire nails. Studding spaced 16-inch centers, 8 pounds of 3d common wire nails.

Bridging, per set for 2 x 10 joists spaced 16 inches centers and 8 nails per set, will require 26 pounds of 8d common, or 38 pounds of 10d common wire nails per 1,000 lineal feet of bridging.

Furring, 1x2, will require 10 pounds of 10d nails, or 7 pounds of 8d nails per 1,000 feet of length.

Framing studding will require 15 pounds of 10d and 5 pounds of 20d nails per 1,000 feet of studding.

Framing joists will require approximately the following amounts of 20d nails per 1,000 feet:

Frame buildings, 16-inch centers.....15 pounds
Frame buildings, 12-inch centers.....20 pounds
Brick buildings, 16-inch centers.....10 pounds
Brick buildings, 12-inch centers.....12 pounds

Finish, ⅞-inch, will require about 20 pounds of 8d finishing nails per 1,000 feet, while 1¼-inch will require 30 pounds of 10d finishing nails per 1,000 feet.

Clapboards will require about 18 pounds of 6d box nails per 1,000 feet.

TABLE XX.

Weight of Wire Nails Needed Per 1,000 Feet of Lumber

Kind of Material	Distance Apart of Joist or Studding Nailing Space in Inches	Number of Nails to Each Board, Each Nailing Space	Size of Nail	Pounds of Nails	Size of Nail	Pounds of Nails
1x 4	12	2	8d com.	57	10d com.	84
1x 4	16	2	8d com.	43	10d com.	65
1x 4	24	2	8d com.	30	10d com.	45
1x 6	12	2	8d com.	38	10d com.	56
1x 6	16	2	8d com.	29	10d com.	43
1x 6	24	2	8d com.	20	10d com.	30
1x 8	12	2	8d com.	28	10d com.	42
1x 8	16	2	8d com.	22	10d com.	32
1x 8	24	2	8d com.	15	10d com.	23
1x10	12	2	8d com.	23	10d com.	34
1x10	16	2	8d com.	17	10d com.	26
1x10	12	3	8d com.	34	10d com.	51
1x10	16	3	8d com.	26	10d com.	39
1x10	24	3	8d com.	18	10d com.	27
1x12	16	3	8d com.	22	10d com.	32
1x12	24	3	8d com.	15	10d com.	23
2x 6	16	2	20d com.	54	30d com.	75
2x 6	24	2	20d com.	37	30d com.	53
2x 8	24	2	20d com.	28	30d com.	40
2x10	24	3	20d com.	34	30d com.	48
2x12	24	3	20d com.	28	30d com.	40
3x 6	24	2	40d com.	45	60d com.	70
3x 8	24	2	40d com.	34	60d com.	52
3x10	24	3	40d com.	41	60d com.	63
3x12	24	3	40d com.	35	60d com.	54
Shiplap						
1x 8	12	2	8d com.	32	10d com.	47
1x 8	16	2	8d com.	25	10d com.	36
1x 8	24	2	8d com.	17	10d com.	26
1x10	12	2	8d com.	25	10d com.	37
1x10	16	2	8d com.	19	10d com.	29
1x10	24	2	8d com.	13	10d com.	20
1x10	12	3	8d com.	37	10d com.	56
1x10	16	3	8d com.	29	10d com.	43
1x10	24	3	8d com.	20	10d com.	30
1x12	12	3	8d com.	30	10d com.	45
1x12	16	3	8d com.	24	10d com.	35
1x12	24	3	8d com.	16	10d com.	25
Flooring						
⅜x2½	12	1	4d fin.	9	5d fin.	13
1x3	12	1	6d flg.	16	8d flg.	27
1x3	16	1	6d flg.	12	8d flg.	21
1x3	12	1	6d com.	28	8d com.	50
1x3	16	1	6d com.	21	8d com.	39
1x4	12	1	6d flg.	11	8d flg.	19
1x4	16	1	6d flg.	9	8d flg.	15
1x4	12	1	6d com.	19	8d com.	35
1x4	16	1	6d com.	15	8d com.	27
1x6	12	1	6d com.	12	8d com.	23
1x6	16	1	6d com.	10	8d com.	18
1x6	24	1	6d com.	7	8d com.	12
1x6	12	2	6d com.	24	8d com.	46
1x6	16	2	6d com.	20	8d com.	36
1x6	24	2	6d com.	14	8d com.	24
1x8	12	2	8d com.	32	10d com.	47
1x8	16	2	8d com.	25	10d com.	36
1x8	24	2	8d com.	17	10d com.	26
Ceiling						
⅜x4	24	1	5d fin.	4	6d fin.	6
⅜x6	24	1	5d fin.	3	6d fin.	4
⅝x4	24	1	6d fin.	6	8d fin.	10
⅝x6	24	1	6d fin.	4	8d fin.	6
¾x6	24	1	6d com.	7	8d com.	12
Siding						
½x4	16	1	6d com.	15	8d fin.	15
½x6	16	1	6d com.	10	8d fin.	10
½x4	16	1	6d fin.	9	7d fin.	10
½x6	16	1	6d fin.	6	7d fin.	7

TABLE XXI.

Standard Steel Wire Nails

Description	Approximate Size of Wire Nails	Approximate No. to Pound
3d fine	1⅛-inch, No. 16	920
3d common	1¼-inch, No. 14½	615
4d common	1½-inch, No. 13	322
6d common	2-inch, No. 12	200
8d common	2½-inch, No. 10½	106
10d common	3-inch, No. 9½	74
12d common	3¼-inch, No. 9	57
16d common	3½-inch, No. 8	46
20d common	4-inch, No. 6	29
30d common	4½-inch, No. 5	23
6d casing	2-inch, No. 13	260
8d casing	2½-inch, No. 13	160
10d casing	3-inch, No. 11	108
4d finish	1½-inch, No. 16	767
6d finish	2-inch, No. 14	359
8d finish	2½-inch, No. 13	214
10d finish	3-inch, No. 12	134
3d shingle	1¼-inch, No. 13	429
6d flooring	2-inch, No. 11	151
8d flooring	2½-inch, No. 10	98
10d flooring	3-inch, No. 9	66
4d box	1½-inch, No. 15	550
6d box	2-inch, No. 13	250

QUANTITIES OF MATERIALS NEEDED IN PAINTING

One pound of paint will cover from 3½ to 4 square yards of wood for the first coat, and from 4½ to 6 square yards for each additional coat; on brickwork it will cover about 3 square yards for the first coat and 4 square yards for the second coat.

One pound of putty will cover about 20 square yards of stopping.

One gallon of ready mixed paint will cover 250 to 300 square feet of wood surface one coat, or 175 to 225 square feet two coats, or 125 to 150 square feet three coats.

One gallon of paint, emerald green, will cover about 25 sq. yards
One gallon of paint, yellow, will cover about 44 sq. yards
One gallon of paint, stone color, will cover about 44 sq. yards
One gallon of paint, white, will cover about 44 sq. yards
One gallon of paint, zinc white, will cover about 50 sq. yards
One gallon of paint, prime color, will cover about 50 sq. yards
One gallon of paint, black, will cover about 50 sq. yards
One gallon of paint, green, will cover about 45 sq. yards
One gallon of paint, bronze green, will cover about 75 sq. yards

One gallon of water stain, 650 square feet on open grained woods, 750 square feet on close grained woods, and about 500 square feet on soft woods.

One gallon of spirit stain, about one-half the capacity of water stains.

One gallon of oil stain, about 600 square feet on either hard or soft woods.

In estimating quantities of materials per square of surface covered, the following proportions are often followed:

Where lead and oil primer is used, new woodwork requires 3¾ pounds of white lead, 1 quart linseed oil, and a little under ½ pint of turpentine per square of woodwork. If used on common brick, 8¼ pounds of white lead, ½ gallon of linseed oil, and a little over ½ pint of turpentine per square.

Coats other than priming coats require 2½ pounds of white lead, 1 pint of linseed oil and ⅛ pint of turpentine per square for woodwork, and 3½ pounds of white lead, 1 quart of linseed oil and ¼ pint of turpentine per square on common brickwork.

LABOR QUANTITIES FOR PAINTING

An average workman will do approximately the following amounts of work in an eight-hour day:

Shellacing knots, 450 square yards.
Puttying defects, 250 square yards.
Lead and oil priming coat, 80 to 100 square yards.
Lead and oil, second coat, 80 square yards.
Dipping shingles, 8,000 dipped 2-3 of length.
Staining shingles one coat with brush, 100 square yards.

SHINGLE STAIN

A good shingle stain may be made by using pure white lead in oil, and strong chrome green in oil, raw umber and a little lampblack, mixed until the desired shade is reached, thinning with boiled linseed oil and a little japan. To a quart of this paint, add for dipping purposes, five quarts creosote oil; and for application with the brush, mix one quart of the oil paint and three quarts of creosote oil.

COVERING CAPACITY OF SHINGLE STAIN

The following estimate of covering capacity of shingle stain is based on the average cedar shingle, size 4 x 16 inches.

One gallon of stain will cover 150 square feet one brush coat or 100 square feet two brush coats.

Two and one-half to three and three-fourths gallons of stain will dip 1,000 shingles. Two-thirds of length of shingle to be dipped.

The covering capacity of creosote bleaching oil is about one-fifth less than the above figures.

DATA COMPILED FROM AUTHORITATIVE SOURCES BY HUNT, HELM, FERRIS & CO.

WEIGHT OF VARIOUS MATERIALS

Weights of Stones—Granite (averages) per cubic foot, 170 pounds; limestone (magnesium), 144 pounds; Berea (sandstone), 140 pounds; free stone, 140 pounds; gypsum, natural state, 140 pounds.

One ton of vein marble is 13 cubic feet; of statuary marble, 13½ cubic feet; granite, 13½ cubic feet; of Berea stone, 14⅓ cubic feet; of limestone (magnesium), 13¾ feet.

Weight of Masonry—Granite, per cubic foot, 160 pounds; Berea stone range, 140 pounds; limestone rubble, 140 pounds; brick, dry, 115 pounds; brick, dry (press), 130 pounds; brick, dry (fire), 150 pounds; brick masonry in mortar, 110 pounds; brick masonry in cement, 112 pounds.

Weight of Marble Slabs—½-inch thick per square foot, 7.17 pounds; ¾-inch thick, 10.75 pounds; 1 inch thick, 14.32 pounds; 1¼ inch thick, 17.92 pounds; 1½ inch thick, 21.05 pounds; 1¾ inch thick, 25.08 pounds; 2 inches thick, 28.67 pounds; 2½ inches thick, 35.83 pounds.

Cement and Lime—One bushel of Portland Cement weighs 96 pounds; of Rosendale, 70 pounds; Louisville, 62 pounds; Quick lime, well shaken, 80 pounds; of quick lime, loose, 70 pounds.

Iron and Wood—One cubic foot of wrought iron weighs 480 pounds; of cast iron, 450 pounds; of oak, seasoned, 48 pounds; of pine, seasoned, 36 pounds.

Coal—One bushel of anthracite weighs 86 pounds; of bituminous, 80 pounds; of coke (Connellsville), 40 pounds; charcoal (hardwood), 30 pounds.

Miscellaneous Weights—Per cubic foot: Ordinary quick lime 53 pounds; old mortar, 90 pounds; new mortar, well tempered, 115 pounds; new mortar, 110 pounds; river sand (average), 107 pounds; river sand (screened), 95 pounds; clay with gravel, 130 pounds; earth, vegetable, 90 pounds; earth, loamy, 100 pounds; earth, semi-fluid, 110 pounds.

WEIGHT OF FLOORS AND THE LOAD UPON SAME

The dead weight of a fireproof floor will average for the arches, concrete, plastering and flooring, 70 pounds per square foot. The live weight, equal to a dense crowd of people, 80 pounds per square foot, or a total for an office building of 150 pounds per square foot.

The following loads are exclusive of weight of arches and beams:

Dense crowd of people	80 pounds per square foot
For floors of houses	50 pounds per square foot
Theatres and churches	80 pounds per square foot
Ball rooms	90 pounds per square foot
Warehouses	250 pounds per square foot
Factories	200 to 450 pounds per square foot
Brick walls	112 pounds per cubic foot
Stone (Chicago limestone dressed)	160 pounds per cubic foot

The Dead Weight of a Wooden Floor, Including Wood Joists

Double flooring and plastering will average	25 pounds per square foot
If deafened	35 pounds per square foot
Stud partition of wood plastered each side	20 pounds per square foot

In estimating the weight of a flat ceiling and roof, it will be safe to assume the following:

Ceiling of wooden construction..... 15 pounds per square foot
Ceiling of iron construction .....25 to 65 pounds per square foot
Roof of wooden construction..... 45 pounds per square foot
Roof of iron construction.....65 to 100 pounds per square foot

The weight of roof includes wind pressure and snow.

TABLE XXII.
WEIGHT OF SUBSTANCES STORED IN BARNS

MATERIAL	Measurements		Weights in Lbs.	
Grain	Floor Space	Cubic Feet	Per Sq. Ft.	Per Cu. Ft.
Wheat in bags	4.2	4.2	39	39
Wheat in bulk	.....	.....	....	44
Wheat in bulk	.....	.....	....	39
Wheat in bulk, mean	.....	.....	....	41
Corn in bags	3.6	3.6	31	31
Cornmeal in barrels	3.7	5.9	59	37
Oats in bags	3.3	3.6	29	27
Bale of hay	5.0	20.0	57	14
Hay, Dederick compres'd	1.75	5.25	72	24
Straw " "	1.75	5.25	57	19
Hay, loose	.....	.....	....	4

HINTS FOR ROOFERS
SLATE ROOFING

The pitch of a slated roof should be about one in height to four in length. The usual lap is about 3 inches, sometimes 5 inches. Each slate should be fastened by two 3d slate nails, either galvanized iron, copper or zinc. On roofs of gas houses the nails should be of copper or yellow metal.

The sides and bottom edges of roof slates should be trimmed, and the nail holes punched as near the head as possible. When slates are not of uniform size they should be stored and the smallest placed near the ridge.

In a first class slate roof the top course on ridge, and the slate from 2 to 4 feet from gutters and 1 foot each way from valleys and hips, should be bedded in elastic cement.

TABLE XXIII.
Table of Sizes and Number of Slates in One Square Foot
1 Square = 100 Square Feet

Size, Inches	No. of Slate in a Square	Size, Inches	No. of Slate in a Square
6x12	533	10x18	192
7x12	457	11x18	174
8x12	400	12x18	160
9x12	355	14x18	137
10x12	320	10x20	169
12x12	266	11x20	154
7x14	374	12x20	141
8x14	327	14x20	121
9x14	291	11x22	137
10x14	261	12x22	126
12x14	218	14x22	108
8x16	277	12x24	114
9x16	246	14x24	98
10x16	221	16x24	86
12x16	185	14x26	89
9x18	213	16x26	78

Roof boards for slate roofs should be covered with one or two thicknesses of tarred felt roofing paper before slates are laid. Dry or rosin-sized felt should not be used on roofs.

To find the length of rafters, giving the roof ⅓ pitch, take three-fifths of the width of the building. If the building is 30 feet wide, they must be 18 feet long, exclusive of projection.

The weight of a square of slate is estimated in a general way, varying according to the thickness of the different makes, at from 600 to 700 pounds per square.

Weight Per Square Foot

Thickness, inch	⅛	3/16	¼	⅜	½	⅝	¾	1
Weight, pounds	1.81	2.71	3.62	5.43	7.25	9.06	10.87	14.5

Weight per cubic foot.....174 pounds.

It requires, on account of laps, an average of nearly 2½ square feet of slate to make one of slating.

TIN ROOFING

A tin roof, properly put on and kept painted, will last thirty years. It ought not to be painted for the first time until it has been on about thirty days, so as to get the grease off the tin, and all the rosin should be carefully scraped off.

It is sometimes necessary, on buildings where there is much dampness or steam, as stables, blacksmith shops, roundhouses, etc., to paint the roof tin one coat on the under side before laying.

Tin roofs should be laid with cleats and not by driving nails through the tin itself.

There are two kinds of tin—"bright tin," the coating of which is all tin, that is the tin proper; and "terne," "leaded" or "roofing" tin, the coating of which is a composition, part tin and part lead. This last is a little cheaper and will not rust any quicker, but the sulphur in soft coal smoke eats through the "leaded" coating sooner than through the "tinned."

There are two sizes of tin, 10x14 and 14x20, and two grades of thickness—IC light and IX heavy. For a steep roof (one-sixth pitch or over) the IC 14x20 tin ("leaded" if high up where little smoke will get to it; "bright" if low down). Put on with a standing groove, and with the cross beams put together with a double lock, makes as good a roof as can be made. For flat roofs 1X 10x14 "light" is best, laid with cleats; but the others make good roofs and any of them will last 25 years at least.

Number of square feet a box of roofing tin will cover: For flat seam roofing, using ½-inch locks, a box of 14x20 size will cover about 192 square feet, and for standing seam, using ⅜-inch locks and turning 1¼ and 1½-inch edges, making 1-inch standing seams, it will lay about 168 square feet.

For flat seam roofing, using ½-inch locks, a box of 28x20 size will cover about 399 square feet, and for standing seam, using ⅜-inch locks and turning 1¼ and 1½-inch edges, making 1-inch standing seams, it will lay about 365 square feet.

Every box of roofing plates (IC or IX 14x20 or 28x20 sizes) contains 112 sheets.

STRENGTH OF PIERS

Granite will sustain 40 tons per square foot; Berea (sandstone), 30 tons per square foot; limestone (magnesium), 29 tons per square foot; portland (sand stone), 13 tons per square foot; brick in cement, 3 tons per square foot; rubble masonry, 3 tons per square foot; lime, cement foundation, 2½ tons per square foot.

SAFE BEARING VALUE OF FOUNDATION SOILS

Material	Tons Per Square Foot
Granite formation	30
Limestone, compact beds	25
Sandstone, compact beds	20
Soft friable rock	8-10
Gravel and sand, compact	6-10
Gravel, dried and coarse compact	6
Clay, dry in thick beds	4
Clay, moderately dry, thick beds	3
Clay, soft	1½
Sand, compact, confined	4
Sand, clean and dry, confined	2
Earth, solid and dry	4

AVERAGE LIFE OF BUILDING MATERIALS

The figures given below are averages deduced from replies made by eighty-three competent builders in twenty-seven cities and towns of western states.

TABLE XXIV.
Life and Depreciation of Building Materials

Material in Buildings	Frame Dwellings		Brick Dwellings (Shingle Roof)		Frame Stores		Brick Stores (Shingle Roof)	
	Average Life, Years	Percentage of Depreciation per Annum	Average Life, Years	Percentage of Depreciation per Annum	Average Life, Years	Percentage of Depreciation per Annum	Average Life, Years	Percentage of Depreciation per Annum
Brick			75	1⅓			66	1½
Plastering	20	5	30	3⅓	16	6	30	3⅓
Painting, outside	5	20	7	14	5	20	6	16
Painting, inside	7	14	7	14	5	20	6	16
Shingles	16	6	16	6	16	6	16	6
Cornice	40	2½	40	2½	30	3⅓	40	2½
Weather-boarding	30	3⅓			30	3⅓		
Sheathing	50	2	50	2	40	2½	50	2
Flooring	20	5	20	5	13	8	13	8
Doors, complete	30	3⅓	30	3⅓	25	4	30	3⅓
Windows, complete	30	3⅓	30	3⅓	25	4	30	3⅓
Stairs and newel	30	3⅓	30	3⅓	20	5	20	5
Base	40	2½	40	2½	30	3⅓	30	3⅓
Inside blinds	30	3⅓	30	3⅓	30	3⅓	30	3⅓
Building hardware	20	5	20	5	13	8	13	8
Piazzas and Porches	20	5	20	5	20	5	20	5
Outside blinds	16	6	16	6	16	6	16	6
Sills and 1st floor joists	25	4	40	2½	25	4	30	3⅓
Dimension Lumber	50	2	75	1⅓	40	2½	66	1½

TABLE XXV—WEIGHTS REQUIRED FOR WINDOWS*

Figure Four Weights of the Size Given for Each Window

Two-Light 1⅜-inch Sash			1¾-inch	
Size	S S	D S	S S	D S
12x24	3	....	....	....
12x26	4	....	....	....
12x28	4	....	....	....
12x30	4	....	....	....
12x32	4	....	....	....
12x34	4½	....	....	....
12x36	4½	....	....	....
14x24	4	....	....	....
14x26	4	....	....	....
14x28	4	....	....	....
14x30	4	....	....	....
14x32	4½	....	....	....
14x34	4½	....	....	....
14x36	5	....	....	....
16x24	4	....	....	....
16x26	4	....	....	....
16x28	4	....	....	....
16x30	4	....	....	....
16x32	4½	....	....	....
16x34	5	....	....	....
16x36	5	....	....	....
18x22	4	....	....	5
18x24	4	....	....	5
18x26	4	....	....	5
18x28	4½	....	....	6
18x30	4½	5	....	6
18x32	5	5½	....	7
18x34	5	5½	....	7
18x36	5½	6	....	7
18x38	5½	6	....	7
18x40	6	7	....	8
20x24	4	5½	....	6½
20x26	4	5½	....	6½
20x28	4½	6	....	7
20x30	5	6	....	7
20x32	5	6½	....	7½

Two-Light 1⅜-inch Sash			Sash	
Size	S S	D S	S S	D S
20x34	5½	6½	....	7½
20x36	5½	7	....	8
20x38	6	7½	....	8½
20x40	6½	8	....	9
22x24	4	5	....	5½
22x26	4½	5½	....	6
22x28	5	6	....	6½
22x30	5	6	....	6½
22x32	5½	6½	....	7
22x34	5½	6½	....	7½
22x36	6	7	....	8
22x38	6½	7½	....	8½
22x40	7	8	....	9
22x42	7½	8½	....	9½
22x44	7½	8½	....	10
22x46	8	9	....	11
22x48	9	10	....	11½
24x24	5½	6½	....	7
24x26	5½	6½	....	7
24x28	6	7	....	7½
24x30	6	7	....	7½
24x32	6½	7½	....	8½
24x34	7	8	....	9
24x36	7	8	....	9
24x38	7	8	....	9½
24x40	7½	8½	....	10
24x42	8	9	....	10
24x44	8	9	....	10
24x46	8½	9½	....	10½
24x48	8½	9½	....	11
26x26	6	7	....	8
26x28	6½	7½	....	8½
26x30	6½	7½	....	8½
26x32	6½	7½	....	9
26x34	7	8	....	9
26x36	7	8	....	9

Two-Light 1⅜-inch Sash			Sash	
Size	S S	D S	S S	D S
26x38	7½	8	....	9½
26x40	7½	9	....	10
26x42	8	9	....	10
26x44	8	9	....	10½
26x46	8½	9	....	11
26x48	9	9½	....	11
26x50	9	10	....	11½
28x28	6½	7½	....	8½
28x30	6½	7½	....	8½
28x32	7	8	....	9
28x34	7½	9	....	9½
28x36	7½	9	....	9½
28x38	8	9	....	10
28x40	8	9	....	10
28x42	8	10	....	11
28x44	8½	10	....	11½
28x46	9	10	....	12
28x48	9	11	....	12
28x50	9½	11	....	12½
28x52	10	12	....	13
28x54	11	12	....	14
28x56	12	16	....	17
30x30	6½	8	....	9
30x32	7	8	....	9
30x34	7½	8½	....	9½
30x36	7½	8½	....	9½
30x38	8	9	....	10
30x40	9	10	....	11
30x42	9½	11	....	13
30x44	9½	11	....	13
30x46	9½	11	....	13½
30x48	10	12	....	14
30x50	10	12	....	14
30x52	11	13	....	15
30x54	11	14	....	16
40x40	13	14	....	14

Four-Light 1⅜-inch Sash		
Size	S S	D S
10x16	4	4
10x18	4	4
10x20	4½	5
10x22	4½	5
10x24	5½	6
10x26	5½	6
10x28	5½	6
10x30	5½	6
10x32	5½	6
10x34	6	6½
10x36	6	6½
12x16	4	4½
12x18	4	4½
12x20	4½	5
12x22	4½	5
12x24	5½	5
12x26	5½	6
12x28	6	6½
12x30	6	7
12x32	6½	7½
12x34	7	8
12x36	7	8
12x38	7	8
12x40	8	9
12x42	8	9
12x44	8	9
14x14	4	4½
14x16	4	4½
14x18	4½	5
14x20	4½	5
14x22	5	5½
14x24	6	6½
14x26	6	6½
14x28	6½	7
14x30	6½	7
14x32	7	8

Four-Light 1⅜-inch Sash		
Size	S S	D S
14x34	7	8
14x36	7½	9
14x38	8	9
14x40	8	9
14x42	8½	10
14x44	9	10

Four-Light 1¾-inch Sash		
Size	S S	D S
15x46	....	13
16x36	....	10
14x42	11	12

TABLE XXVI.
BUILDERS' ESTIMATING DATA

Quantity of material in every four lineal feet of exterior wall in a balloon frame building, height of wall being given:

Length of Studs	Size of Sills	Size of Studs, Braces, etc.	Quantity of Rough Lumber	Quantity of inch Boarding	Siding in Sup. Feet	Tar Paper in Sup. Feet
8	6x 6	2x4 Studs	42	36	40	74
10	6x 8	4x4 Braces	52	44	50	80
12	6x10	4x4 Plates	62	53	60	96
14	6x10	1x6 Ribbons	69	62	70	112
16	8x10		82	71	80	128
18	8x10	Studs	87	80	90	144
20	8x12	16 inches from	98	88	100	160
22	9x12	Centers	109	97	110	176
24	10x12		119	106	120	192
18	10x10	2x6 Studs	122	80	90	144
20	10x12	6x6 Braces	137	88	100	160
22	10x12	4x6 Plates	145	97	110	176
24	12x12	1x6 Ribbons	162	106	120	192
26	10x14		169	114	130	208
28	10x14	Studs 16 inch	176	123	140	224
30	12x14	Centers	198	132	150	240

Amount of lumber in rafters, collar-piece and boarding, and number of shingles to four lineal feet of roof, measured from eave to eave over ridge. Rafters 16-inch centers:

Width of House, Feet	Size of Rafters	Size of Collar-piece	Quantity of Lumber in Rafter and Collar-piece	Quantity of Boarding, Feet	Number of Shingles
14	2x4	2x4	39	91	560
16	2x4	2x4	45	70	640
18	2x4	2x4	50	79	720
20	2x4	2x4	56	88	800
22	2x4	2x4	62	97	880
24	2x4	2x4	67	106	960
20	2x6	2x6	84	88	800
22	2x6	2x6	92	97	880
24	2x6	2x6	101	106	960
26	2x6	2x6	109	115	1,040
28	2x6	2x6	117	124	1,120
30	2x6	2x6	126	133	1,200

Special Division
FARM CONCRETE WORK

Wherever you find good red-blooded farmers with progressive ideas, you'll find staunch friends of concrete.

These farmers are in business to make money. And they all know that *concrete construction* on the *farm* pays big returns on the *investment.*

Time saved is money earned. Concrete saves both time and work. Besides that, it makes for better and more sanitary conditions which means higher quality products—better prices—a better reputation.

With the result that you'll find concrete in its many and various adaptations on every modern, well managed farm.

Where you *don't* find it, you'll find a market *for* it.
Where you *do* find it you find a *better* market.

Because the farmer who already *has* capitalized on concrete construction never has to be sold the idea involving *other* money saving uses. Experience has sold him already—and sold him hard. All you have to do is point these *new uses* out to him.

And they are *many*.

The barnyard offers a big field of opportunity for the use of concrete.

Concrete foundations under the barn, *pay*.

So do concrete floors and good drainage systems.

So do concrete hog wallows—oftentimes extended until they cover the entire *barnyard*.

So do concrete *stock tanks* and *manure pits*.

And so do concrete *walls* which protect the stock from winter winds.

They *all* pay. And all *progressive* farmers *know they* pay.

FIVE REASONS FOR CONCRETE IN THE BARNYARD

Cleanliness—Concrete is sanitary and most easily cleaned. On butter and *milk*-producing farms, improvements making for more sanitary conditions are necessary, not only for convenience and common cleanliness but because they are in some states compulsory by law. The cleaner the barns, the equipment and environments, the better the product and the more it brings on the market.

Rodent Proof—Rats, mice and other rodents are germ carriers and are troublesome where grain is stored or fed to animals. Concrete construction keeps the rodents out. It not only saves the grain but protects the stock from infection and disease.

Permanence—Concrete construction *once* built is *always* built. It pays for itself over and over again in the saving of repairs alone.

Simplicity—No more work is involved in building a permanent structure of concrete than would be required to build and keep in repair the same kind of a wooden structure.

Economy—The first cost of a concrete installation is but a trifle over and above that of inferior forms of construction, the *difference* being quickly forgotten in the *long enduring* and *better* service rendered. Farmers have found that it is cheaper to pay the *price* of *quality* service than the *penalty* of *inferiority* and govern themselves accordingly.

CONCRETE FLOOR CONSTRUCTION

Sub-base for Inside Floors—Whether or not to use a sub-base under a concrete floor depends on the nature of the soil and upon whether the floor is indoors and protected, or outdoors and subject to freezing. In inside work where the ground is firm and thoroughly settled a sub-base is unnecessary, but the ground must be compact and moisture must not go below the finished floor if there is a possibility of freezing. If a sub-base is not used the ground should be sprinkled with water and compacted with a tamper. But if it is necessary to fill in the space below the floor with loose dirt, a sub-base is advisable. Ordinarily 6 to 8 inches of gravel is sufficient. This should be compacted and leveled off before laying the floor.

Sub-base for Exposed Floors—For outside work, if the soil is heavy and holds water, a gravel sub-base is necessary, and no matter what kind of earth is to be covered, a sub-base is necessary if the ground is so sloped that surface water can run down below it. Yet with a good, natural drainage and a loose soil a sub-base is not needed.

For outside work, the gravel or cinders should be 8 inches deep and well compacted by wetting and tamping.

Floor Forms—Floor forms must be placed carefully. Make them of 2x4's or larger planks, held rigidly in place by strong stakes set close enough together so that the form will not bulge. The floors should have a pitch or slope of ⅛ to ¼ inch to the foot to drain properly.

Drainage—Besides pitching the floor, avoid dips or hollows in the surface in which water would stand. Make the floor drain to a gutter along the middle or along one side and keep the surface free from hollows by using a straight-edge across the floor forms. The kind of gutter or drain will be explained later, as it varies with the type of floor.

Thickness, Mixture and Consistency—Single course floors for farm buildings should be 5 to 6 inches thick with concrete mixed in a proportion of 1 sack of cement to 2 cubic feet of coarse clean sand and 3 cubic feet of screened gravel or crushed stone. Sometimes ¾ to 1 inch top coat of mortar is added to the concrete to improve the surface. Make this in a proportion of 1 sack of cement to 2 cubic feet of sand.

For single course work use enough water so that the concrete is "quaky." It will then need a little tamping. If a top coat of rich mortar is to be put on, the first course should be drier and then it will need sound tamping to make the concrete compact and bring the water to the surface.

Single Course Work—For floors of barns, hog and poultry houses, sheep sheds and ice houses, one course work is sufficient. In this case the entire slab is placed at one time and the top finished off with a wooden trowel. A mortar coat as used for sidewalks is not put on, but a small amount of mortar may be spread over the surface if necessary to trowel the surface smooth. It is good practice to brush the concrete with a broom before it is hard, so as to give a better footing for animals along runways and in the stalls.

Surface Coat—Mangers and gutters are improved by giving a thin coat of cement mortar and finishing with a steel trowel. Troweling draws the cement and finer sand particles to the top, making the surface smooth, but too much of this treatment should be avoided.

Floors of milk houses and creameries should be finished in this way, making the surface coat ¾ inch thick. You must not fail to put on the finished coat before the concrete forming the body of the floor is hard and dry. If it should become dry you must clean and wet it thoroughly before putting on the mortar. If you are working during hot weather you should protect the floor for several days to prevent drying out. Wet straw is a good protection but it should not be put on until the concrete has begun to set or it will mark the surface. Keep the straw damp for a week or ten days. This is especially necessary for outside floors exposed to the sun. If you are working in freezing weather use warm materials and cover up the work with straw or manure for a week or ten days.

Expansion and contraction—Do not build concrete floors inside buildings without cutting up into squares 10 feet or less in both directions and for outdoor floors do not make the squares larger than 6 feet in either dimension. This prevents cracking as a result of expansion and contraction, due to changing temperatures. The lines of division must extend through the entire depth of the slab, as a line marked on the surface will do no good whatever.

HOG WALLOWS

Construction—The general shape and construction of a good hog wallow is shown in Fig. 6. It is most convenient to make the pool rectangular with rounded corners and a depth of not over 18 inches. A pool 15 to 20 feet long and ten feet wide will be found amply large. A concrete floor 4 feet wide laid around the wallow will prevent the hogs from burrowing under or carrying in mud.

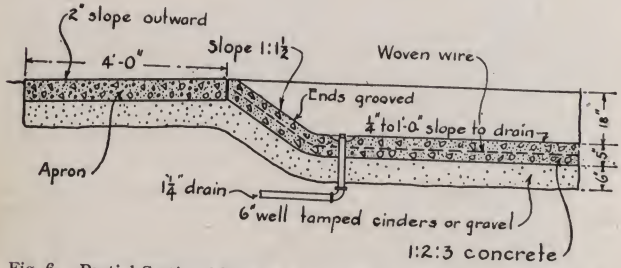


Fig. 6. Partial Sectional View of a Concrete Hog Wallow. The Wallow is Simply a Big Concrete Bowl With a Floor Four Feet Wide Around the Edge

HOG HOUSE FLOORS

Construction—Make hog house floors 6 inches thick, of 1:2½:4 concrete. Finish off the surface with a wood float and roughen it with a broom.

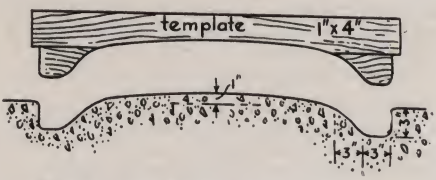


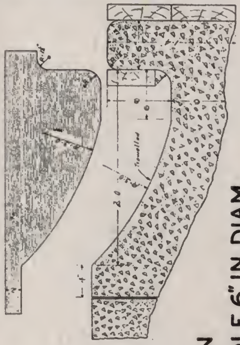
Fig. 14. Type of Open Drain and Template for Forming the Gutter

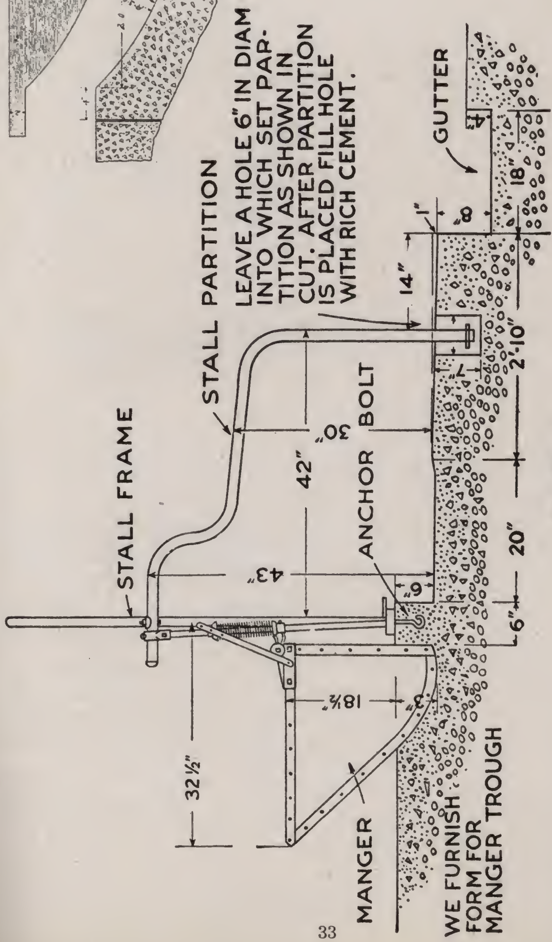
DAIRY BARN FLOORS

Design—Cut No. 1 shows a sectional view and elevation of a cow barn floor with mangers and gutter molded in concrete. It is planned for adjustable steel stalls and the length of the stall is that needed for cows of average size.

Construction—In laying the floor, follow the general instructions of the preceding pages. You should lay the floor in front of the manger first, which should be 18 inches above the level of the floor or drive back of the gutter. It should be a single course slab 5 inches thick and sloped ¼ inch per foot toward the manger. Level the forms to obtain this slope.

Manger and Curb—The next section to be laid is the manger and curb, which should be 6 inches thick. building up the curb so as to extend about 6 inches above the surface of the stall floor. Put up a rigid plank to form the side of the curb and build a templet as shown below, to bring the manger to shape. Put a little extra mortar on the surface and finish it with a steel trowel, leaving the surface quite smooth.





Cut No. 1

Cut No. 1 showing cross section of **Star Adjustable Stall No. 1**, with correct measurements to be followed in laying out of cement curb, gutter, feed trough and the 6 inch holes into which partitions are set.

STOCK TANKS
Circular

Because of its shape, a circular tank will resist freezing better than a rectangular tank. The circular form of tank gives a greater capacity for the same amount of material, yet the forms are difficult to construct and, therefore, somewhat expensive. If several farmers will buy a form to use jointly in building several tanks it may be wise to use a circular form but one farmer alone had best use the rectangular shape.

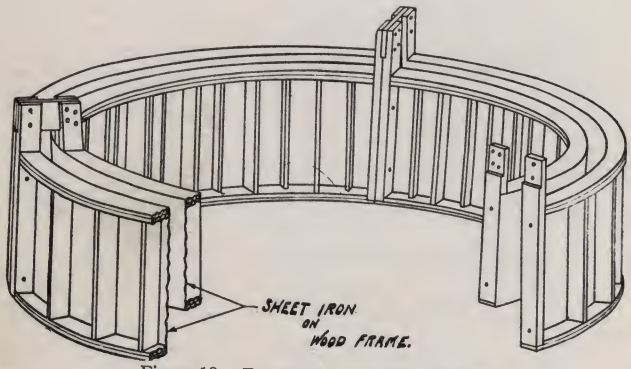


Figure 19. Forms for Circular Stock Tank

Tank Form—The form shown in Fig. 19 was designed by Alfred Olson of Elkhorn, Wis., and has been successfully used for many years.

The sub-base and floor foundation for a circular tank should be built the same as for a rectangular tank and it is generally more convenient to make the foundation on which the tank rests rectangular rather than circular.

Base—Build a square slab foundation 2 inches greater in diameter than the proposed tank. Place 2 inches of concrete in the form, tamp it thoroughly, place a layer of 1-inch poultry netting over the whole surface and fill with concrete up to the proposed level of the outer floor. The concrete should be tamped and troweled smooth at least on the corners which the tank will not cover. The form should then be placed on the foundation slab, after it has had a sufficient time for hardening, and the succeeding steps are identical with those for a rectangular tank.

The floor surrounding the tank may be round if the entire barnyard is not to be floored, or rectangular if it is part of a larger floor system.

TABLE XXVII

Volume of Compacted Cement, Sand, Mortar and Stone or Gravel Concrete Per Sack of Cement, Also Materials Required

Mixtures			Materials			Vol. in Cubic Feet	
Cement	Sand	Gravel or Stone	Cement in Sacks	Sand in Cu. Ft.	Gravel or Stone Cu. Ft.	Mortar	Concrete
1	1½		1	1.5		1.75	
1	2		1	2.0		2.1	
1	2½		1	2.5		2.48	
1	3		1	3.0		2.82	
1	1½	3	1	1.5	3.0		3.52
1	2	3	1	2.0	3.0		3.9
1	2	4	1	2.0	4.0		4.48
1	2½	4	1	2.5	4.0		4.85
1	2½	5	1	2.5	5.0		5.45
1	3	5	1	3.0	5.0		5.80
1	3	6	1	3.0	6.0		6.40

TABLE XXVIII

Materials Required for One Cubic Yard of Compacted Cement, Sand, Mortar and Stone or Gravel Concrete

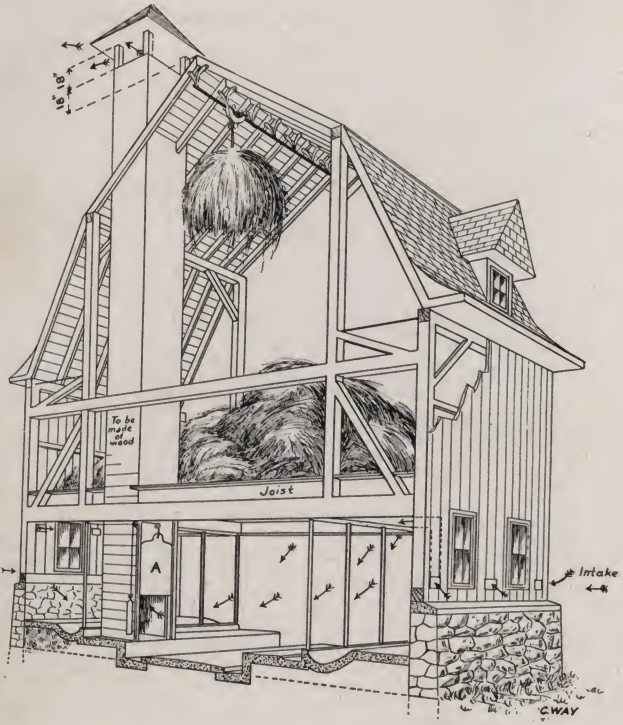
Mixtures			Quantities of Materials				
Cement	Sand	Stone or Gravel	Cement in Sacks	Sand		Stone or Gravel	
				Cu. Ft.	Cu.Yds.	Cu. Ft.	Cu. Yds.
1	1½		15.48	23.2	.86		
1	2		12.84	25.6	.95		
1	2½		10.96	27.3	1.01		
1	3		9.56	28.6	1.06		
1	1½	3	7.64	11.3	.42	23.0	.85
1	2	3	6.96	14.0	.52	20.8	.77
1	2	4	6.04	12.2	.45	24.0	.89
1	2½	4	5.56	13.8	.51	22.1	.82
1	2½	5	4.96	12.4	.46	24.8	.92
1	3	5	4.64	14.0	.52	23.2	.86
1	3	6	4.24	12.7	.47	25.4	.94

Stone and gravel considered as having 45% voids.

Tables based on 1 sack cement=1 cubic foot.
4 sacks cement =1 barrel.

NOTE—These quantities may vary 10% in either direction, depending upon the materials used and the compactness of the concrete.

Based on tables in "Concrete—Plain and Reinforced," by Taylor and Thompson.



AN EFFICIENT VENTILATING SYSTEM

Perspective view of one center bent of barn, showing relation of ventilator to the hay fork, the timbers of the barn, the gutter, and the relation of the fresh air intakes to the foul air out-take or ventilator. The outlet chute should be built on the ratio of 5 or 6 cows to the square foot. There should be enough intakes about one-half square foot in area evenly distributed around the outside of the stable to nearly equal the area of the outlet shaft. There should be four square feet of window area per cow. Slide *A* can be adjusted to regulate the size of the opening in accordance with the temperature of the barn.

This system is practical, inexpensive and is absolutely perfect in its operation. Our architectural expert will be glad to plan a ventilating system to meet your individual requirement.

In the Back of this Book is a Specimen of the Floor Plan Blue Prints We Furnish You Free—

Look over this specimen blue print carefully.

When you ask our dealer in your town for a Floor Plan Blue Print, he sends us the details and we make it up to your order and put your name and that of your customer right where he can see that you have had it made especially for his job.

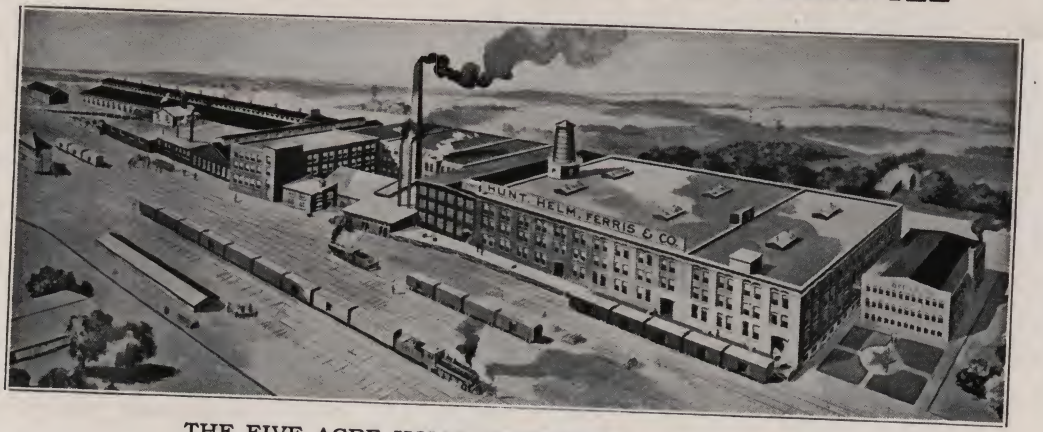
And we do another thing in connection with this service, we attach to every blue print a clear, understandable, type-written explanation so you don't have to take the trouble to figure it out. A blue print from us is self-explanatory.

In requesting blue prints it is important that you give our dealer the information he requests so we can work intelligently.

The only obligation you are under in ordering these Blue Prints is to consider "STAR GOODS" sold by our dealer in your town when you get the job.

Hunt, Helm, Ferris & Co., Harvard, Illinois

THE ESTABLISHMENT BEHIND THE GUARANTEE



THE FIVE ACRE HOME OF STAR BARN EQUIPMENT

Guarantee of Quality

We Know Our Goods to be the Best That Money, Brains and "Know-how" Can Put Together, Hence This Ironclad, Binding Guarantee

We Absolutely and Positively Guarantee *all goods manufactured by us to give satisfaction to the user in every respect. This guarantee applies not only to workmanship and material but to construction and operation as well.*

Should any article manufactured by us prove defective, notify us and we will replace same without one penny's cost to you.

Hunt, Helm, Ferris & Company.

By W B Bell *Treas.*

Table of Contents

PART II.

Condensed Catalog of Star Goods Made by Hunt, Helm, Ferris & Co.

Why Star Goods Appeal to Your Customers

Star Barn Equipment appeals to the farmer because it saves time, labor and money.

More than that, Star Barn Equipment actually makes money.

Farmers all over the world know that a clean, sanitary barn means bigger, quicker profits.

They know that cows give more milk and better milk when they are comfortable and contented.

Star Barn Equipment keeps barns cleaner with less work than any other line on the market. And it keeps the animals happier and more contented.

Farmers like Star Equipment *best* because it does the *most*.

The Star Line is the result of over thirty years of manufacturing experience and is built to *make good* by those who know *how*. It does more for the farmer than other lines for the reason that it embodies all the really practical features of other lines but in addition has a large number of exclusive features that both save labor and insure greater comfort for stock—features that are found in no other makes.

These labor-saving, profit-making features are described herein in connection with the devices themselves; and to these features plus the best materials, and the most durable construction commandable by brains, capital and experience, is due the phenomenal success of the Star Line—the largest, most complete and most sanitary line of barn equipment on the market.

Better service at *least* cost—best service at *any* cost—biggest tangible returns on the investment — that is the keynote of Star success and popularity.

That is why the farmer gives Star Equipment his enthusiastic preference once he has its exclusive money-making advantages *pointed out to him*.

Why Star Goods Appeal to the Contractor

The better a farmer is pleased with his barn, the better advertisement that barn is going to be for you. BUT—

—the farmer's *ultimate* satisfaction is going to be measured by the money he makes *off* the barn. That is largely a matter of equipment and is *one* reason why you should recommend and specify Star Barn Equipment.

But not the *only* reason.

Besides making money for the farmer, Star Barn Equipment *makes money* and *saves money* for YOU. It is the most easily installed barn equipment on the market. It saves time—saves work—saves expense for the contractor. It enables him to do a clean, quick job in record breaking time, pack up his tools and start work on another contract.

Take Star Unit Stalls for instance.

Star Stalls are built in units and are shipped already assembled.

This *assembled unit construction* is one of the exclusive advantages offered you and the farmer by Star Stalls. Compared with the common method of shipping steel stalls as mere bundles of pipe and bags of castings, this assembled unit construction is so much *better*, so much more *practical*, there is absolutely no comparison.

It means money saved for the farmer. He can buy as many or as few stalls as he needs, letting his stalls grow with his herd.

It means time saved for you. You have no assembling to do—no fitting, filing, cutting—all you do is set a row of anchor bolts in the curb, then go ahead with your concrete work.

By the time this is done, your curb containing the anchor bolts is cured and set. Then you can bring in your assembled unit stalls, set 'em over the anchor bolts, make the simple connection—and leave for the next job knowing that your last one was done RIGHT and done without the loss of a moment of valuable time.

Compare this method of installing stalls with the one commonly in vogue—where you have to take time to set posts, take time to true 'em up, take time to brace 'em up, take time to dodge around 'em with your barrows, take time to put the stalls together, take time to find lost parts, take time to inspect the job when it's done, etc.

Can't you see where all that is the rankest kind of *time-waste?* Doesn't equipment that *saves* it mean just so many more cold dollars of profit in your own pocket? Isn't it going to pay you in dollars and cents to install the equipment that *does* save it—Star Equipment?

(For contractor's directions for installation, see page 46.)

And this, mind you, is only one of a score of features that will interest you, as well as the user, in Star Barn Equipment.

One Barn Sells Another

Every farmer for whom you build a barn with an installation of Star Barn Equipment is doubly enthusiastic.

He's enthusiastic over a modern, well constructed building for the better care of his stock.

He's enthusiastic over all the work and worry saved him by Star Barn Equipment.

Enthusiasm spreads like the measles.

He tells his friends he's pleased and he tells them the *reason why.*

And for every detail contributing to his satisfaction, you get *full credit.*

Thus, one barn helps to sell another. And, because Star Barn Equipment best performs the functions which make the barn necessary, it is one of the strongest arguments for a new contract that you can possibly employ.

Farmers Ask You This

"How is Star Barn Equipment going to help me in the more resultful management of my herds?"

That is the question asked by the farmer who may not already be familiar with the Star Line.

That is the question the contractor advocating this equipment must be prepared to answer.

So the following pages besides indicating the advantages of Star Barn Equipment from the *contractors'* standpoint, also describe in as few words as possible the actual benefits derived by the man who is going to use them after the contractor has picked up his tools and left.

We have furnished you with the information following because we *believe* it will help you, and because we *know* you can help us.

Will you?

Star Steel Stalls and Stanchions

Fig. 521. Adjustable

Exclusive Star Features

Here are the time saving features that differentiate Star Stalls and Stanchions from all others.

Unit System

When the business man starts up his correspondence file he buys one or two vertical file sections and adds to them as his needs require.

The unit construction of Star Stalls permits the farmer to apply the same principle in his dairy barn. Instead of being obliged to buy more stalls than he has cows for, he can get as many or as few as he wants, adding to them as fast as he needs them. His stalls thus grow with his herd. His money is not tied up in stalls that he cannot use.

Adjustable Stalls

Star Stalls can be easily adjusted to fit the animals put in them.

Adjustable Stanchions

The only adjustable steel stanchion with a practical wood lining.

Adjustable Hangings

Our stanchions are hung in the stall frames with the most approved double chain hanging which may be adjusted and made as loose or as tight as you please. This double chain hanging permits freedom backward and forward but not sidewise—thus the animals are kept comfortable but cannot steal each other's feed.

Star Stanchions are in no way connected with the concrete. When the bolts or burrs holding them become worn they may be easily removed and replaced without the necessity of tearing out the curb.

Fig. 511

Exclusive Star Features

Alignment Device

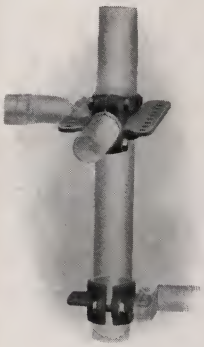


Fig. 509

The easiest way to keep the cow clean is to keep the stall clean. If the cow stands right—at the drop—the stall will be clean.

This knowledge has prompted the invention of a number of schemes to align all cows evenly at drop.

Recently an attempt has been made to bring this about by adjusting only the position of the stanchion. The result is merely to poke the stanchion back a few inches on the cow's neck. Moreover, the adjustment irons project back into the stall and the cow is liable to serious injury from them.

A Successful Way

Only one safe, successful way of regulating this has been discovered. That is to have the *entire front* of the stall movable. In *our* adjustable stall, the front of the stale the whole stall frame or arch, stanchion and all, can be moved backward. This actually shortens the cow bed and brings the short cows into line at the gutter.

The stall frame, in which the stanchion hangs, is secured on each side by four malleable castings (two at the top and two at the bottom) which allow a ten-inch adjustment. See Figs. 509 and 513.

Fig. 513

Star Sure-Stop

The bowed steel bar or sure-stop attached to the side of stanchion, prevents the cow from putting her head through the wrong opening. It in no way interferes with the freedom of the cow, as does a rigid sure-stop attached to the stall frame. It is always in place. In a practical dairy, the swinging type of sure-stop attached to the stall used by some other manufacturers, is not used 50% of the time. It requires a special operation to put it in place. The Star Sure-Stop is always in place, and requires no attention from the operator.

Star Units Come all Assembled

When a thing comes to you all assembled, you know that it is all there and that all parts fit.

Unit System Equipment comes all put together; set each stall in place, attach to the anchor bolts and the job is done.

This feature appeals especially to contractors as it means a saving of time, trouble and work in installation.

Easy to Install

We have already told you how easy it is to install Star Equipment. All you do is line up, and set your anchor bolts in the curb and then go ahead with your concrete work. When you are through, bring in your stalls (all assembled) bolt them in place—and you are done.

Exclusive Star Features—Continued

Dodging around all the posts and braces commonly found in stall construction may be profitable to the barrow-man who gets paid by the day. But it's a dead loss to the contractor—a loss to him that Star Equipment *saves.*

No Interference with Cement Work

For Star Equipment you set a row of anchor bolts in the curb and complete your cement work with nothing to interfere. Set up the stalls, just as you take them from the railroad company, anchor each stall, fasten them together and let the farmer bring in the cows.

"Time is money;" see what you save right there.

The expense of installing other equipment—about one-third of its price—makes the actual cost to the farmer much more than Star Equipment.

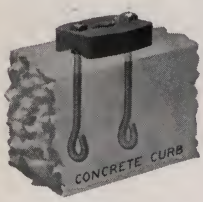


Fig. 512

A Shipment of Star Stalls

Star Stalls are put together before shipping and are easily installed.

Adjustment of Width

All of our stall arches are uniform in size and design, but may be used in stalls of any width. They are connected with each other by means of malleable castings of the three different sizes. The length of these malleables determine whether the stall is to be three feet, three feet three inches, or three feet six inches wide. Of course, the stall can be furnished in other widths, but these are the preferred sizes in general use. See Fig. 508.

Fig. 508

Star Steel Stall Partitions

This feature is the most profitable part of the whole stall. Each cow has her own space. The danger of crowding or trampling each other is thus done away with.

If *one partition* prevented the ruination of one cow, which might have her udder stepped on and destroyed, that saving alone would more than pay for all the partitions in a big barn.

The rear end of the partition sets in cement, making it permanent and rigid. Flanges are furnished to securely fasten these partitions when used on wood floors.

A double curve in the partition enables the cow to turn her head and back out of the stall easily.

Star Steel Arches

Note in figure 521, the unique construction and the perfect sanitary features of Star Steel Arches. Star Steel Arches are each made of a single length of tubing, both ends of which are connected to a cross bar at the base of the stall. No malleables at top to catch dust—smooth, round, a combination that makes Star Stalls clean and sanitary.

Star Steel Tubing

In the construction of our stalls, we use a very high grade steel tubing, manufactured especially for our use by an old and reliable manufacturer. All tubing is tested in every way, is especially strong and durable and will withstand the severest strain.

"Star Adjustable Stalls Line the Cows at the Gutter"

STALL UNITS

Adjustable No. 1

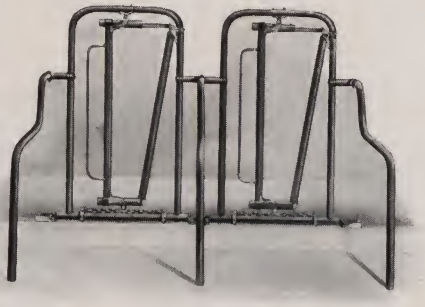


Fig. 521

This stall and stanchion combines all the desirable features an equipment of this kind could have. The stall is adjustable. This doesn't mean that the stanchion will be poked back an inch or two on the cow's neck, but the whole stall front and all that goes with it can be moved back to accommodate short cows.

This actually shortens the cow bed and brings the cow close enough to the gutter to keep the stall clean and the cow clean. The length of the bed governs the cleanliness of the cow and the cleanliness of the cow controls the cleanliness of the milk.

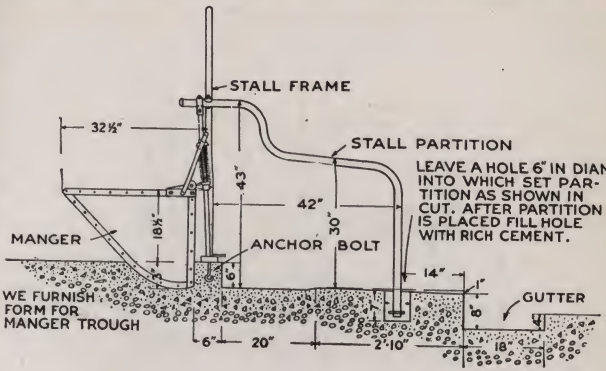
Don't fail to read the full description of the Giant Stanchion with which this stall is fitted on page 56.

Fig. 521 complete, per stall	$7.10
Fig. 521 without sure-stops, per stall	6.60
Galvanized	9.00
Galvanized, without sure-stop	8.40

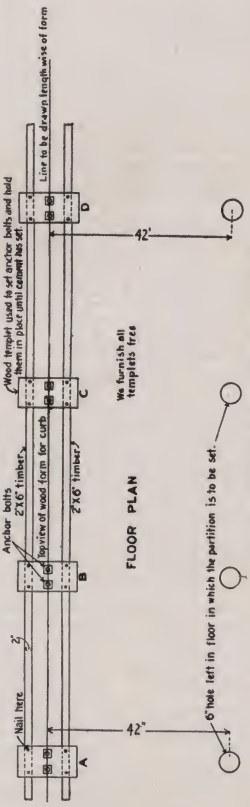
The stalls described above are set up in the following manner: (See diagram on next page.)

Follow Carefully

Set up forms made of 2x6-inch timber, spacing them to give the proper thickness to the curb. See that they are well braced and that the tops are level. Stretch a line through the center lengthwise of the forms. Place one of the curb plates fitted with anchor bolts so that the anchor bolts will hang down between the forms and directly under the chalk line as indicated at A. Square the templet with the form and nail in place. Place the second curb plate at B in like manner, using the STEEL spacing bar placing same over the anchor bolts. This is necessary to give it the proper spacing from A. Do likewise at C, D, etc. Be careful to work the cement well under each of the wooden templets. After the cement has set sufficiently to hold the anchor bolts from shifting, you may remove the nuts and take the templets off. Cement must be well hardened before the nuts on the anchor bolts are drawn down tight, otherwise they will pull out. For convenience in setting partitions, 6-inch holes should be left in the cement floor. After the partition is set, fill in with thin, rich cement. Care should be taken that these holes are placed as shown on the drawing to assure proper alignment of partitions.



CUT NO. 1 SHOWING CROSS SECTION OF STAR ADJUSTABLE STALL NO. 1. WITH CORRECT MEASUREMENTS TO BE FOLLOWED IN LAYING OUT OF CEMENT CURB, GUTTER, FEED TROUGH AND THE 6 INCH HOLES INTO WHICH PARTITIONS ARE SET.



SEE DIRECTIONS ON OPPOSITE PAGE

CUT NO. 2 (VIEW FROM ABOVE) SHOWING MANNER OF SPACING ANCHOR BOLTS IN THE CURB FOR NO. 1 ADJUSTABLE STALL

STAR UNITS

Adjustable No. 2

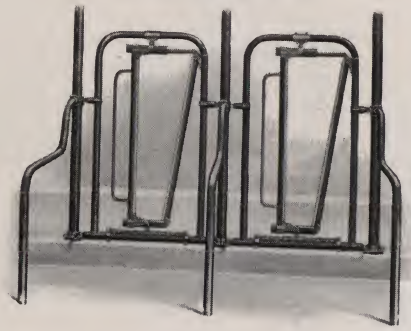


Fig. 525

This stall is the same as Adjustable No. 1, except that it is built to be used in connection with steel posts which support the floor above. The whole front of the stall moves back and regulates the length of the cow bed. This lines the cows up evenly at the gutter and is a long step toward keeping the cow clean and producing clean milk.

Attempts are being made to do this same thing by adjusting the position of the stanchion alone. All this does is to change the place where the stanchion rests against the cow's neck. The adjustment irons protruding back into the stall, right in the center where the cow stands, are dangerous. They are liable to cause abscesses on the brisket or otherwise injure the cow.

This stall is shown equipped with the Giant Stanchion. (See Page 56.)

This stall may be fitted with manger partition or manger if desired.

Price as illustrated, per stall	$7.60
Without sure-stop, per stall	7.10
Galvanized, per stall	9.50
Galvanized, per stall, without sure-stop	8.90

The above price does not include the two-inch steel supporting posts.

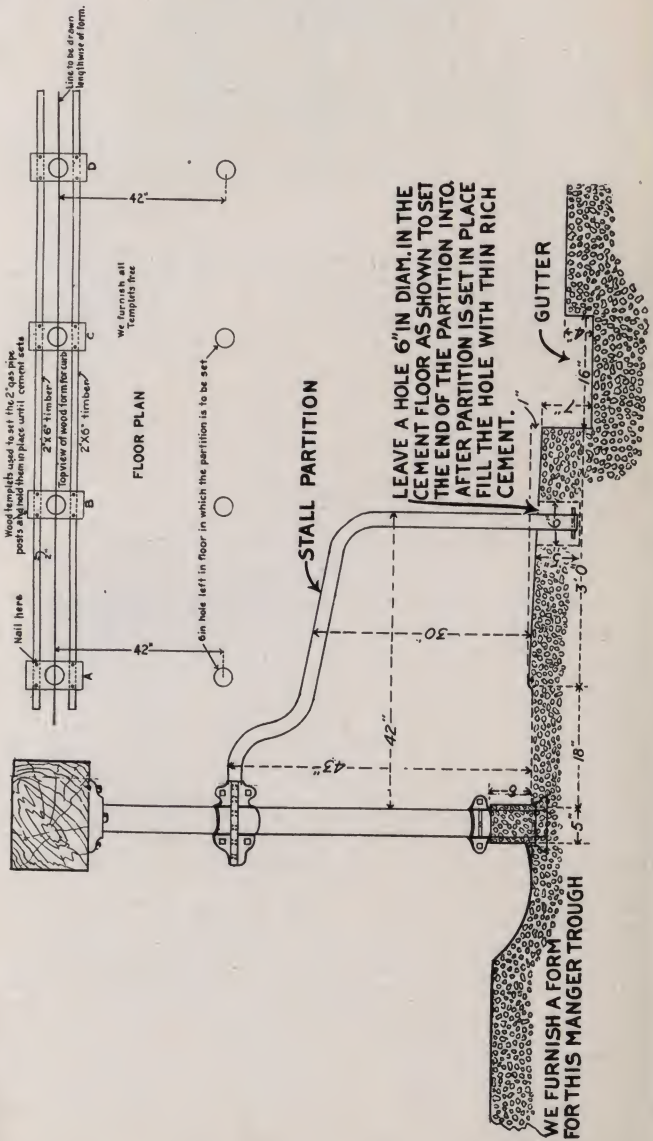
The stalls described above are set up in the following manner: (See diagram on opposite page.)

Directions for No. 2 Stall

Set up form made of 2x6-inch timbers, spacing them to give the proper thickness to the curb. See that they are well braced and that the tops are level. Stretch a line through the center lengthwise of the forms. Place one of the templets as indicated at A so that the center of the hole is directly under the line. Square the templets with the form and nail in place. Place a second templet at B in like manner, using the spacing bar to give it the proper spacing from the one at A. Do likewise at C, D, etc. Next, set the supporting posts by placing the lower end of the posts through the holes in the templets. Put a cap on the top and bottom of each post and block the post up to its proper height. Plumb the post on all sides. This must be done very carefully, as it is very necessary to have the posts plumb, or the stalls will not fit. In filling the forms, see that cement is worked well up under the

templets. After the cement has set, remove the templets from the supporting posts and bolt the stall arches in place. For convenience in setting partitions, 6-inch holes should be left in the cement floor. After the partition is set, fill in with thin, rich cement.

Care should be taken that these holes are placed as shown on the drawing, to assure proper alignment of partitions.



STALL UNITS

Non-adjustable No. 1

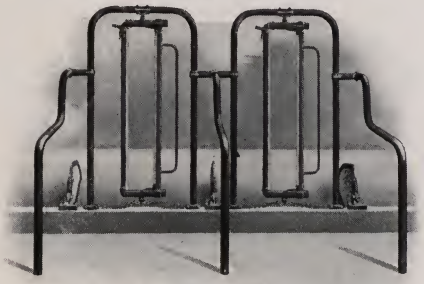


Fig. 517

This Unit has the same shaped partition as the two preceeding Units, but is made with an arch, the legs of which are embedded 6 inches in the cement curb. It is, however, fitted with the Giant Adjustable wood lined steel Stanchion No. 486, described on page 56. This stanchion makes the Unit worth more than the others by reason of being adjustable in neck width and having a strong, practical wood lining.

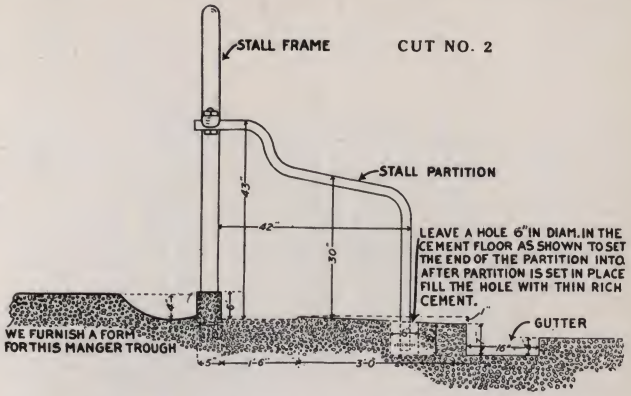
It is shown above with sure-stop.

Price, with manger partitions, as shown	$ 8.35
Price, without manger partitions	6.60
Price, without manger partitions or sure-stop	6.10
Galvanized, each stall as shown	10.25
Galvanized, without manger partitions	8.50

The stalls described above are set up in the following manner:

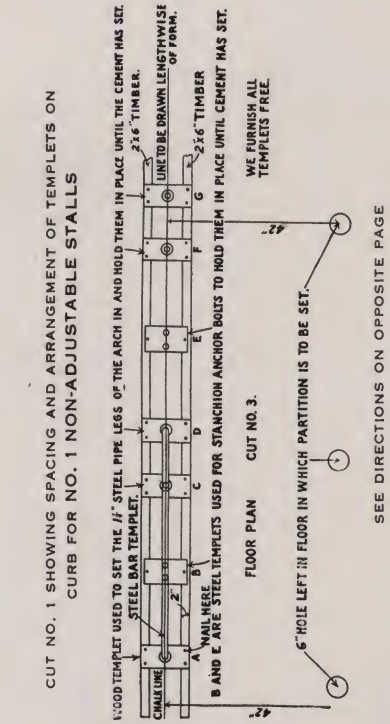
Follow Carefully

Set up forms made of 2x6 timber, spacing them to give the proper thickness to the curb. See that they are well braced and that the tops are level. Stretch a line through the center lengthwise of the forms. Place one of the templets or gauges so that the hole will be directly under the line as indicated at A. Square the templet with the form and nail in place. Place a SHEET METAL templet at B and a WOOD templet at C and D, using the STEEL BAR templet as shown in cut number 3, to give them the proper spacing from the one at A. Do likewise at E, F and G. Use the SHEET METAL templet to hold the stanchion anchor bolts in place, until cement has set. Use the WOOD templets to hold the stall arches in place. This is accomplished by inserting the leg of the arch through the hole in the WOOD templet. The arch is held at the proper height by placing a nail through a hole in the leg of the arch. Be careful to work the cement well under each of the templets. After the cement has set thoroughly, remove the nuts from the anchor bolts and take the sheet metal templets off, replacing them by the stanchion supporting casting. The cement must be well hardened before the nuts on the bolts are drawn down tight, otherwise they will pull out. The wood templets may be split and taken off in that way. For convenience in setting partitions, 6-inch holes should be left in the cement floor. After the partition has been placed, fill these holes with thin, rich cement. Care should be taken that these holes are placed as shown on the drawing to assure proper alignment of partitions.



CUT NO. 2 SHOWS CROSS SECTION OF STAR NON-ADJUSTABLE STEEL STALL NO. 1, WITH CORRECT MEASUREMENTS TO BE FOLLOWED IN LAYING OUT OF CEMENT CURB, GUTTER, FEED TROUGH AND THE 6-INCH HOLES INTO WHICH THE PARTITIONS ARE SET.

CUT NO. 1 SHOWING SPACING AND ARRANGEMENT OF TEMPLETS ON CURB FOR NO. 1 NON-ADJUSTABLE STALLS



SEE DIRECTIONS ON OPPOSITE PAGE

STALL UNITS

Non-adjustable No. 2

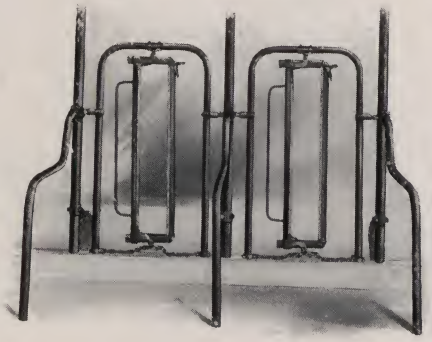


Fig. 526

Exactly the same as No. 1 Non-adjustable, except that it is attached to steel posts running up from the floor and forming a support for the ceiling. These posts, properly arranged, will support the first floor of the barn and all the weight above it.

The stanchion illustrated is the Giant. That is enough to say about it. Look at page fifty-six and you will understand what this means.

Fig. 526 complete Unit as illustrated.....$8.35
Fig. 526 without manger partitions..... 6.60
Fig. 526 without manger partition or sure-stop.....6.10

This price does not include two-inch steel supporting posts.

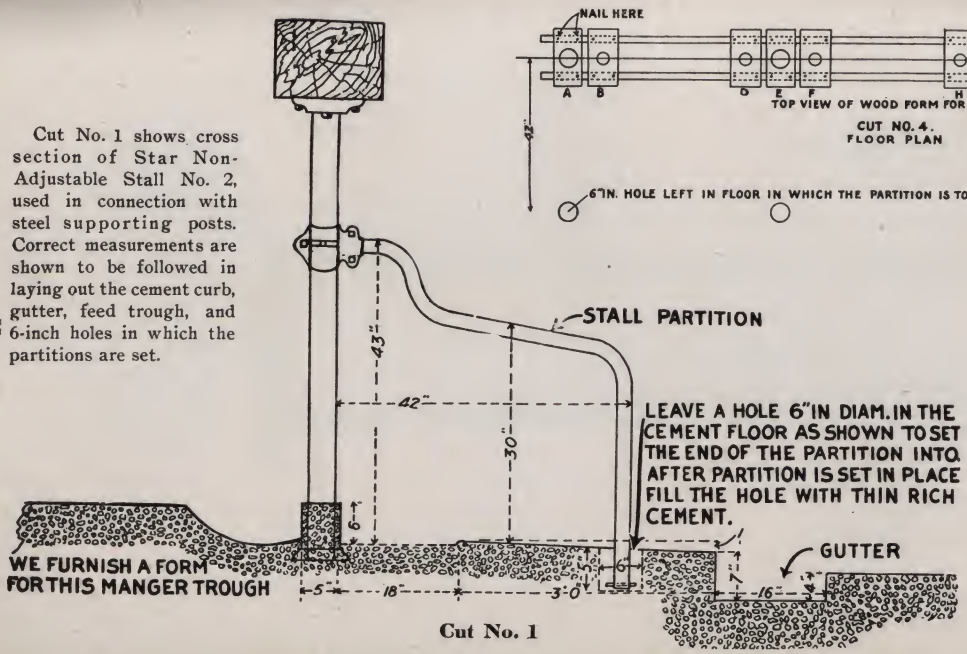
The stalls described above are set up in the following manner:

Follow Carefully

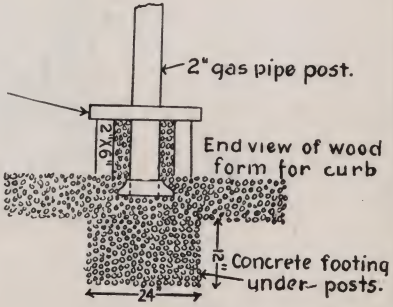
Set up form made of 2x6 timbers, spacing them to give the proper thickness to the curb. See that they are well braced and that the tops are level. Stretch a line through the center lengthwise of the forms. Place one of the WOOD templets as indicated at A so that the center of the hole is directly under the line. Square the templet with the form and nail in place. Place other templets at B, D and E in like manner using the steel templet to give them the proper spacing from the one at A. Do likewise at F, H, I, J, L, M, etc. Next erect the 2-inch supporting posts A, E, I and M by placing the lower end of the posts through the holes in the templet. Put a cap on the top and bottom of the post, and block the post up to its proper height. Plumb the post on all sides. This must be done very carefully, as it is very necessary to have the posts plumb, or the stalls will not fit. Next set the 1¼-inch pipe, stanchion arches as shown at B-D, F-H and J-L, by placing the lower ends of the arch through the holes in the templets. Put a nail through the hole in the leg of the arch at B, D, F, H, J and L, this will keep the arch at the proper height until the cement has set. In filling the forms see that the cement is worked well up under the wood templets. After the cement has set, remove the wood templets from the supporting posts and stanchion arches. For convenience in setting partitions, 6-inch holes should be left in the floor. After the partitions are placed, fill these holes with thin rich cement.

Care should be taken that these holes are placed as shown on the drawing, to assure proper alignment of partitions.

Cut No. 1 shows cross section of Star Non-Adjustable Stall No. 2, used in connection with steel supporting posts. Correct measurements are shown to be followed in laying out the cement curb, gutter, feed trough, and 6-inch holes in which the partitions are set.



Cut No. 1



Cut No. 3

THE GIANT STANCHION

Fig. 486

GIANT STAR STANCHION

No description of mere words could do justice to the Giant Star Stanchion. It is the perfection that has been the aim of all makers and embodies several distinct advantages to be had in no other stanchion.

The Giant Lock is an exclusive feature. The stanchion always locks perfectly and may be opened with one hand. The farmer doesn't have to set down the pail of milk to turn the cow loose. The lock is fitted with a guide which connects the ends of the upright. This insures perfect operation of the lock, even after years of wear. Our "U" clamp fits the side of the stall frame and holds the stanchion in place when open.

Fig. 510. The Giant Lock

Just by loosening two screws the Giant may be adjusted to a bull or a calf without taking it out of the stall frame.

The accompanying cut shows a cross section of the upright. The U-bars are of extra quality steel, lined with hard maple. This maple is thoroughly kiln dried. When we say thoroughly, we mean thoroughly—in the Star Way. The lining is cut by the latest improved machinery and imbedded in this bar by mechanical force. It is impossible to loosen this wood when once applied. It swells a little when exposed to the moisture in the stable; this wedges it in for keeps. It can't possibly be crowded off and presents a smooth surface to the cow's neck.

By making them in large quantities we save on raw material and labor. We are thus able to offer this stanchion with all its advantages, unquestioned strength, adjustability, "grown-on-to-it" wood lining, guided lock and our guarantee of satisfaction for $2.10. Galvanized, $2.40.

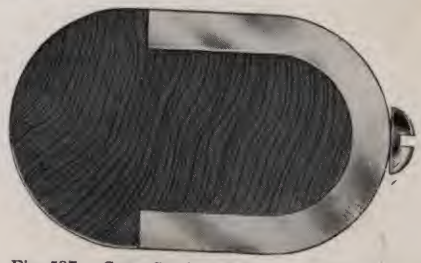


Fig. 537. Cross Section of Giant Star Stanchion Showing Wood Lining

ADJUSTABLE STEEL STANCHION

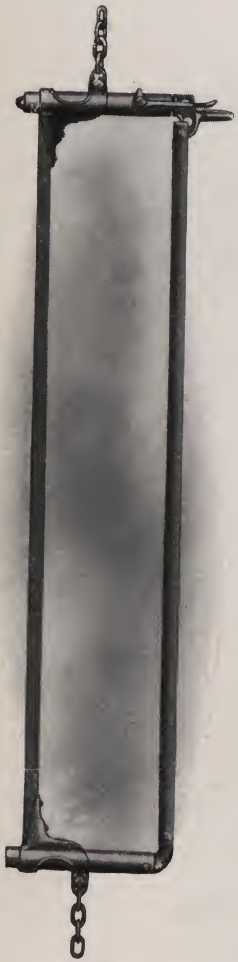


Fig. 434

This stanchion has all the advantages of any other make, with the added advantage of being instantly adjustable in width of neck space.

It is made of high carbon steel U-bars of sufficient strength to hold the heaviest cow, and at a moment's notice may be adjusted to accommodate a calf, without taking the stanchion out of the stall frame.

The lock is heavy and works perfectly. A crotch-shaped device on the latch fits against the stall frame when the stanchion is open and holds the stanchion in place. It is fitted with a guide so that the upper ends of the stanchion will come together and lock perfectly, even after years of service.

It is built to last.

Price	$1.70
With sure-stop	2.20

Weight, 21 lbs.

NON-ADJUSTABLE STEEL STANCHION

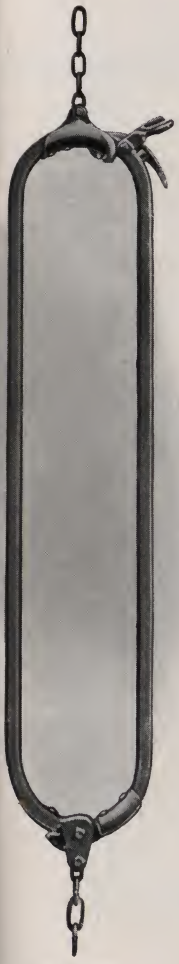


Fig. 449

Here is a stanchion which makes a comfortable, convenient, lasting tie. It is simple, yet strong. The sides are of special high carbon U-bar steel, with the smooth, rounded surface turned in. The malleable lock is strong and sure and works easily. A crotch-shaped device on the latch fits against the side of the frame and locks the stanchion in place when open.

The hinge is of dovetail design, very strong, and will not open far enough to allow the loose arm of the stanchion to fall.

A practical, durable stanchion at a moderate price, each $1.40

Weight, 16 lbs.

STAR ADJUSTABLE WOOD STANCHION

Fig. 452

Our Star Adjustable Wood Stanchion with malleable latch meets all the requirements of those desiring a perfect wood stanchion with adjustable feature.

This stanchion embodies all the desirable features of the various wood stanchions now made. The uprights are of the best hardwood and are strong and durable. The cross-pieces are of the best malleable iron and not of wood as is the case in other stanchions. These malleable parts are securely bolted to the uprights and are, in addition, rigidly held in place by malleable braces. This construction renders it practically indestructible. Being adjustable in neck space from 4½ to 7½ inches, it can be used for calves and yearlings or for the largest cattle. The latch is automatic in operation; one piece of malleable iron and no springs; furnished chain or swivel hung, as desired. Shipped chain hung unless otherwise specified.

Weight, 15 lbs.

Price $1.50

STAR NON-ADJUSTABLE WOOD STANCHION

Fig. 243

Steel Latch

The STAR NON-ADJUSTABLE WOOD STANCHION supplies the demand where the adjustable feature is not required.

The uprights are made of the best hardwood lumber, strong and durable.

The cross-pieces at the top and bottom of the stanchions are made of high carbon angle steel. securely bolted to the uprights.

The stanchion which we carry in stock for general use is 4 feet 4 inches high, with neck space of 6½ inches. Furnished with 4½-inch 5-inch or 5½-inch neck space if desired.

Weight, each, 13 lbs.

Price $1.10

Pivot or chain hung.

MANGER PARTITIONS

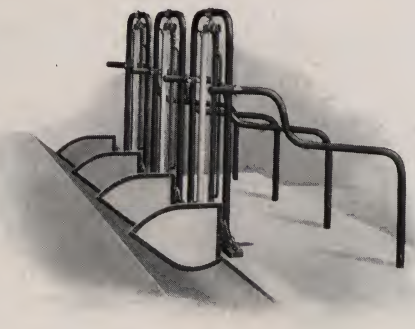


Fig. 515

Above shows manger partitions in position during feeding.

Fig. 518

Above cut shows manger partitions pushed back out of way for cleaning.

The manger partitions with which this stall is fitted are of heavy reinforced galvanized steel. They are used with concrete mangers and prevent the cows from stealing each other's feed. This gives the slow eaters an even chance. They may be used with any of our stalls and are tipped back out of the way while the feed manger is being cleaned.

Price each $1.75

We furnish builders or dairymen with forms by which to construct the concrete mangers, into which the manger partitions fit. A very convenient form, whether our stall equipment is used in connection with it or not.

STAR SELF-CLEANING SANITARY STEEL MANGER

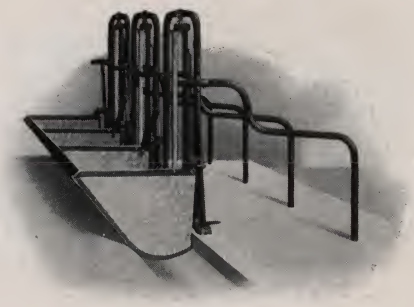


Fig. 524

Mangers in position during feeding.

Self-cleaning mangers are the final touch to perfect equipment.

They give each cow an individual feed box. Each will eat just what you give her, neither too much nor too little, and it will pay for itself in the waste of feed that it prevents and saves.

There is no bottom to the manger. It fits into the concrete feeding trough and is raised and held in place by strong springs while the trough is being cleaned. This bottomless manger prevents the gathering of dirt in the corners.

The trough into which the manger fits makes a convenient water trough.

Manger may be used with any stall unit.

Mangers, per stall..... $3.50

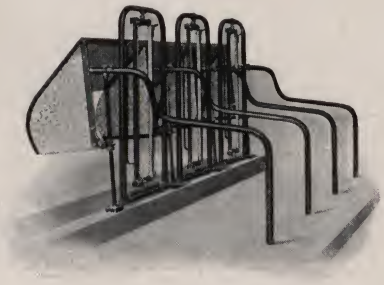


Fig. 523

Mangers raised to clean cement trough.

STAR STEEL BULL PEN

Fig. 529

This is the strongest pen made. We use 1⅝ O. D. steel tubing. Notice the arch construction, bolted by extra heavy malleable couplings to the top rail. This gives a rigidity and neatness not found in other makes.

The arch over the gate makes the whole front of the pen rigid. *The sides of the pen are assembled at the factory.* Just couple the corners and set into cement.

The gate is so hinged that it swings back flat against the pen. The double pin, extra heavy lock (of Hall Safe pattern) locks automatically and is unlocked by a wheel four inches in diameter. It can't be unlocked by accident.

Bull pen is 5½ feet high and has bars 4½ inches apart, and weighs 35 lbs. per foot. Price, per linear foot, in aluminum finish $2.00
Galvanized 2.50

Arches and fittings for gate 3 feet 10 inches wide, including double pin (Hall Safe pattern) lock. Price, in aluminum finish $5.00
Galvanized 6.00

Pen may be fitted with rigid stanchion to hold bull while cleaning pen. Price, in aluminum finish $3.00
Galvanized 3.50

Star Sanitary Self Cleaning Lifting Manger, for bull pen, a great feed saver. Weight, 60 lbs. Price $5.00

Hay rack shown in cut prevents waste of hay, 36 x 36 inches. Weight, 50 lbs. Price $5.25

This bull pen may be installed at the same time that the concrete floor is laid, or a trench may be arranged 6 inches wide and of about the same depth, in which to set the bull pen after the balance of the floor has been laid and hardened.

STAR STEEL COW PEN

Fig. 530

The careful dairyman no longer allows his cows to pass through the calving period in the stanchion, risking the loss of the calf and injury to the cow. At this time more care and attention than ever is needed. Quarters should be clean and roomy, where there is plenty of fresh air and light. When cows are sick, good nursing is often the secret of speedy recovery.

The Star Cow Pen affords the ideal quarters. It is easily cleaned, disinfected and put in perfectly sanitary condition. The construction is the same as that of the calf pen except that it is as high as the bull pen. It is assembled at the factory and installed like the calf pen. It weighs 32 lbs. per foot.

The price of the cow pen per linear foot is $1.90 in aluminum finish. Galvanized, $2.40.

Gate arches and fittings per set, in aluminum finish, $3.00. Galvanized, $3.50.

Tilting manger as shown in cut $10.00

Or it may be provided with a self-cleaning sanitary lifting manger. Price, $5.00. Weight, 60 lbs.

The hayrack shown in the illustration is a great saver of feed, size 36 x 36. Weight, 50 lbs. Price, $5.25.

This cow pen may be installed at the same time that the concrete floor is laid, or holes may be left 6 inches wide and of about the same depth, in which to set corner posts and gate arches after the balance of the floor has been laid and hardened.

STAR STEEL CALF PEN

Fig. 531

Farmers realize that the best of care must be taken of the calves as they are the future herds. Many calves are lost each year which might easily be saved by proper care in clean, sanitary, comfortable surroundings.

The Star Calf Pen is just what the farmer wants. It is strong, simple and easily set up. It is of the same general construction as the bull pen, except that we use 1⅝-inch steel tubing for top, bottom and corners, and 1⅛-inch tubing for uprights and stanchions. The sides are assembled in sections. The corner posts and gate arch are all that have to be imbedded in cement. Price of the calf pens, 4 feet high, including stanchions, per foot, $1.70. Galvanized, per foot, $2.20.

Weight per foot, 30 lbs.

The stanchions, by means of a continuous locking bar, can be opened and closed at one time or singly, as desired. They may be varied in neck space according to the size of the calf.

Feed guards as shown in the illustration prevent the calves from forming the habit of sucking each other's ears. They may be raised to clean the manger trough as shown in the upper picture. Feed guards, each, $1.75

Arches and fittings with which gate is equipped, including a single pin, Hall Safe pattern lock, which locks automatically.

Price, in aluminum finish $3.00
Galvanized 3.50

This calf pen may be installed at the same time that the concrete floor is laid, or holes may be left 6 inches wide, and of about the same depth, in which to set corner posts and gate arches after the balance of the floor has been laid and hardened.

ALLEY GATE

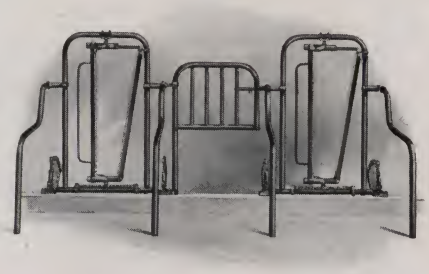


Fig. 528

Alley Gate in Row of Stalls

One of the handiest features of Star Unit System Stalls is that a stall may be removed any time and an alley made through a row of stalls. This alley can be made wherever the farmer wants it and whenever he wants it, an exclusive feature of Star Equipment. To prevent the cows going through this opening and getting loose in the feel alley, a gate as shown above is set in place of the stall frame. This gate is of steel tubing, strong and durable, fitted with spring latch and swings both ways.

Price, 3 ft. to 4½ ft. wide, in aluminum finish $5.00
Same, Galvanized 6.00

Furnished in any width.

STAR LITTER CARRIER

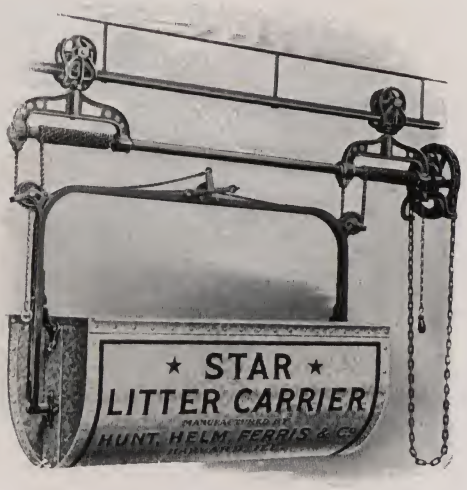


Fig. 333

Star Litter Carriers are noted for speed, ease of operation and durability. They stand for two distinct profits to the farmer. First, they save wages because with them, the farmer can do more with less help. Second, they keep the barn more clean and sanitary, meaning a higher grade product. So Star Litter Carriers *pay their way.*

The carrier pictured above is the fastest and easiest raising and lowering carrier made. The main shaft is supported at four points, all roller bearing and the large drive wheel fitted with an endless chain, is attached directly to it, no gearings or cogs to become worn or loose. Its very simplicity commends it to the man of practical mechanical knowledge, as there is nothing about it to get out of repair.

The large tracker wheels are roller bearing and run on a rigid track. It runs easy.

This, like all Star Carriers, has a rigid bail which holds the tub in shape and insures perfect working of the locks at both ends.

The tub is of heavy galvanized steel, reinforced with angle bars.

With No. 2 Tub, 8 bushels, wt., 80 lbs., price $21.35
With No. 4 Tub, 10 bushels, wt., 90 lbs., price 22.70
With No. 6 Tub, 12 bushels, wt., 100 lbs., price 24.00
With No. 8 Tub, 14 bushels, wt., 130 lbs., price 25.35

STAR MILK CAN CARRIER

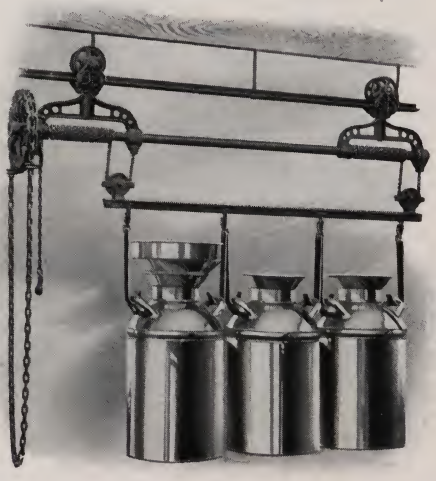


Fig. 413

The conveyor is the same as that of carriers shown on pages 68 and 70 which, by reason of its simplicity, is the best and most practical overhead carrier made.

The cans may be lowered to within a few inches of the floor where they may be strained into easily and still remain clean.

When filled they are again lifted and run into the milk house where they may be lowered into the cooling tank without being handled. Afterwards they may be raised from the tank and taken out to the wagon.

A man can handle but one can at once, but with this carrier he can handle three in practically the same time, do it with less effort and furthermore save time in other operations.

It saves time—pays its way—in the dairy house just as Star Litter Carriers do.

You can get out of this work for the rest of your natural days for the price of this carrier..... $14.70

Weight, 55 lbs.

STAR FEED CARRIER

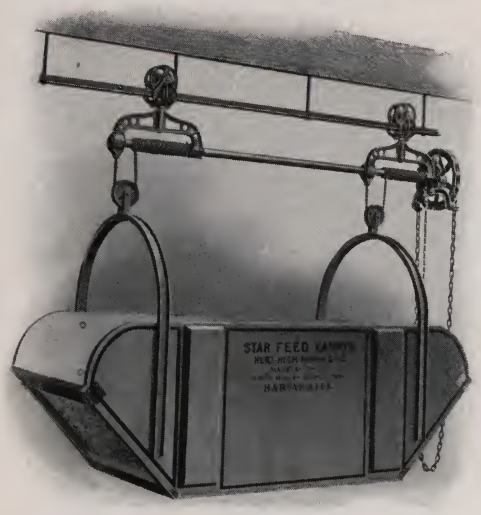


Fig. 334

A feed truck or carrier will save lots of time and work. The overhead carrier has the same tub as the feed truck. This is suspended from the conveyor at four points and the main shaft as well as the large parallel tracker wheels are roller bearing throughout. This makes an easy-running and easy raising and lowering carrier. Weight, 200 lbs.

This carrier is for rigid carrier track described on page 71.
Price $25.35

STAR FEED TRUCK

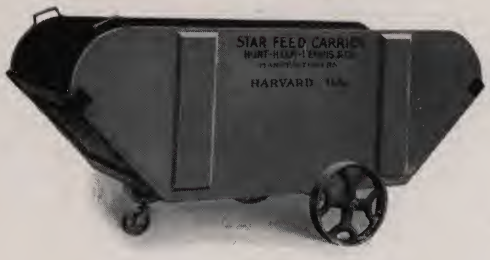


Fig. 443

The Star Truck shown above is so balanced on the wheels that it may be easily run and can be turned around in its own space. It is 68 x 26 inches and is 24 inches high. It holds 14 bushels. It will save lots of steps with a heavy feed basket or shovel. Sides of hardwood. Bottom and ends of heavy galvanized iron. Both ends slanting to make unloading easy and prevent spilling feed. Weight, 200 pounds.

Price $20.00

RIGID DOUBLE ANGLE STEEL TRACK

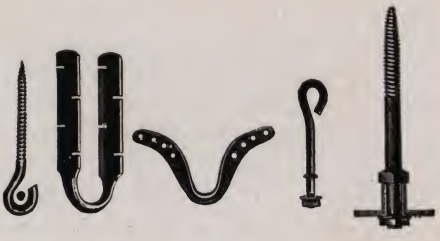
The rigid double angle track lends the same ease of operation to all Star Carriers.

Star track is rigid and will not bend or buckle. It will support the heaviest load. Price per foot, $0.12.

Fig. 444

Below the supports for rigid track are shown: There should be one about every two feet.

Fig. 339 Hook Hangers, 6¾-inch; per doz.	$0.85
Fig. 339 Hook Hangers, 11¾-inch, per doz.	1.20
Fig. 339 Hook Hangers, 13¾-inch; per doz.	1.40
Fig. 339 Hook Hangers, 15¾-inch; per doz.	1.60



Figs. 376 87 126 339 414

Fig. 126 shows joist bracket used with Hanger No. 339.

Price, per doz. $0.50

Fig. 87 is our ridge pole hanger, also used with Hanger 339. It fits a 2-inch pole or joist. A nail in each slot holds it fast.

Price, per doz. $1.00

By means of the Lag Screw Hanger, Fig. 414, page 71, the track may be adjusted to perfect level, even if the joists do not hang evenly. They are made in the following lengths.

Price, 10¼-inch, per doz., wt., 3 lbs. $1.00
Price, 15¼-inch, per doz., wt., 3½ lbs. 1.35
Price, 17¼-inch, per doz., wt., 4 lbs. 1.55
Price, 19¼-inch, per doz., wt., 4½ lbs. 1.75
Price, 20¼-inch, per doz., wt., 5 lbs. 1.95

Getting Out of the Barn

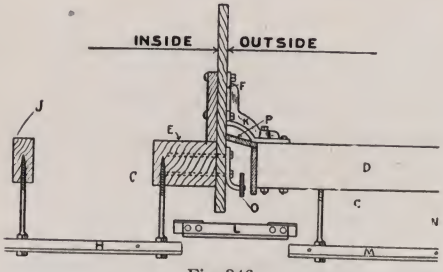


Fig. 346

In order to allow the operation of doors, a removable section of track is furnished. This always falls into place and fits perfectly, and is as rigid as any other part of the track.

Price $0.55

Fig. 361

Fig. 361 shows a bracket by which a ridge pole is supported at the end near the barn. This holds the end of the pole away so that it will not interfere with the working of the sliding door.

Price $0.80

SWINGING BOOM

Fig. 472

The slight extra cost of the swinging boom is soon returned in the convenience of having the barnyard free of obstructions. With the boom there are no posts or braces to look out for, everything is up out of the way.

After experimenting with pipe, I-beams and other things we have demonstrated that our present plan is the safest and best. This boom is of heavy 2x2-inch galvanized steel angles, clamped together and supporting the track.

Weight, per foot, complete, 7 lbs.

Booms are furnished in lengths up to 45 feet.

Price, per foot, not including track or hangers	$0.60
Hangers for boom, per doz.	1.00

SWITCHES AND CURVES

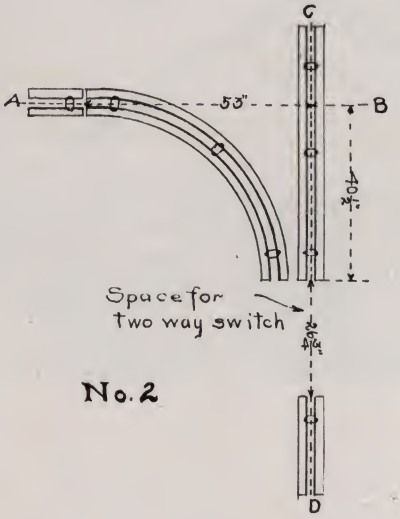
Switches and curves for our track, like all Star equipment, embody only the best tried-out principles and are practical, simple and strong—built for service.

They are perfect in their operation, the switches being shifted by a simple pull of a chain.

Price, two-way switches, each	$4.00
Price, three-way switches, each	4.70
Price, curves of 4-foot radius, each	1.65

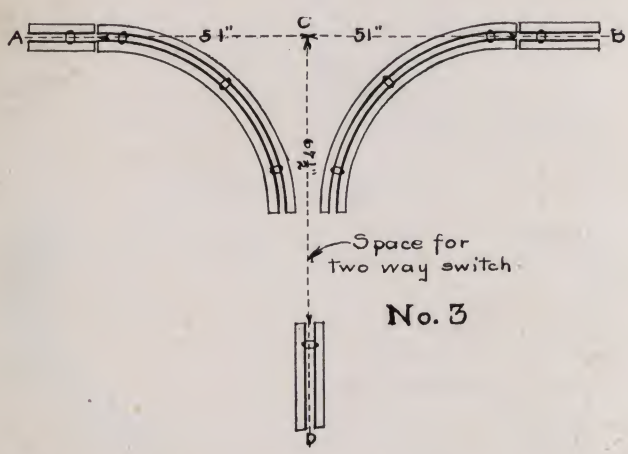
In ordering be sure to state whether curve is to be used with or without switch.

DIRECTIONS FOR INSTALLING THE NEW SAFETY STEEL SWITCH

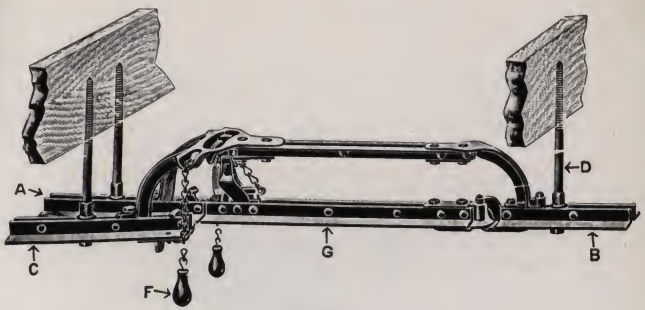


Draw a line tightly through barn where you desire to install track, as shown in dotted lines A, B, C and D as shown in cuts 2, 3 and 4.

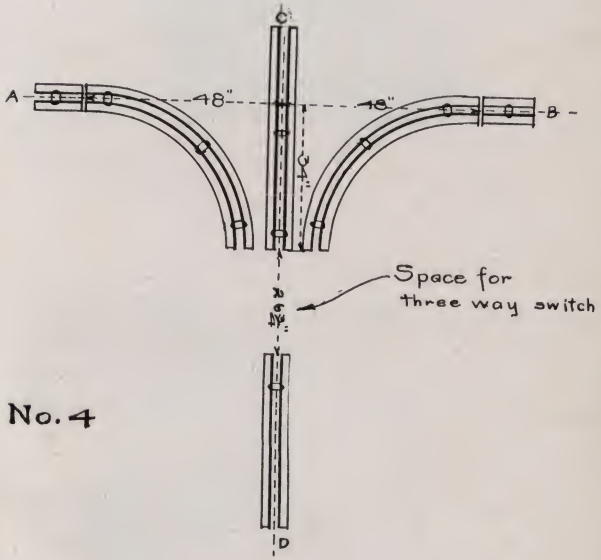
If you wish to use a straight way track with either right of left curve, use measurements from Cut No. 2.



If you desire a straight way track with a right and left curve, take measurements from Cut No. 3.



Cut No. 1



No. 4

To install a three-way switch, see Cut No. 4. First, place switch in space as shown in Cut. Draw up all splice bolts tightly. Place track supporting hangers as close to ends of switch as possible. See Cut No. 1. Also use a lag screw through slot at top of frame at E. If there are no joists where the hangers D, D and E are, put in a 2 x 6 header.

Keep All Working Parts Well Oiled

STAR ROD TRACK CARRIER

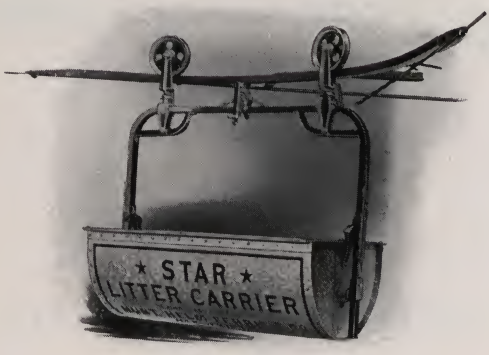


Fig. 405

All Star Carriers for rod track are run on 8-inch tracker wheels, with wide, lathe-turned tread, which prevents friction against the side of track. Each wheel has 12 extra long cold rolled steel bearings, surrounded a shouldering axle pin of special rolled steel, turned to 1-1,000 of an inch, so the bearing is friction-less. This makes the carrier run easy.

The frame is of the best malleable iron, heavily ribbed, and is much stronger than the required capacity.

The malleable keepers held in place by steel springs prevent the wheels from jumping the track. They also lock the wheel parallel with the track, unlocking automatically and permitting the truck to swivel freely at curves.

The support is riveted to both bail and brace bail, forming a rigid truss.

The bail is of special rolled channel steel, which gives great strength without excessive weight.

The rigid bail ensures perfect operation of the locks at both ends as well as keeping the tub from racking.

These carriers dump either way at any desired point where the trip is set, and return automatically to the barn.

The carrier Fig. 405 shown opposite, is the most practical made. Rigid bail, heavy all-steel reinforced tub and all the features noted with No. 2 Tub. Weight, 110 lbs.

Price $16.00

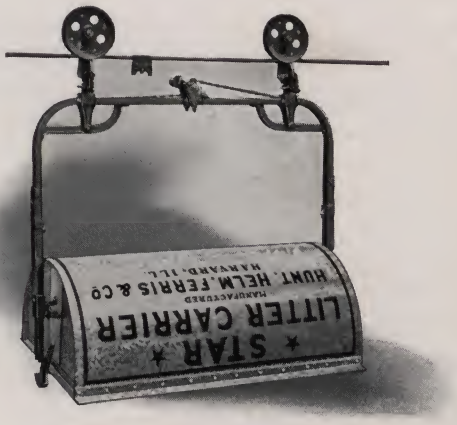


Fig. 405

RAISING AND LOWERING CARRIER FOR ROD TRACK

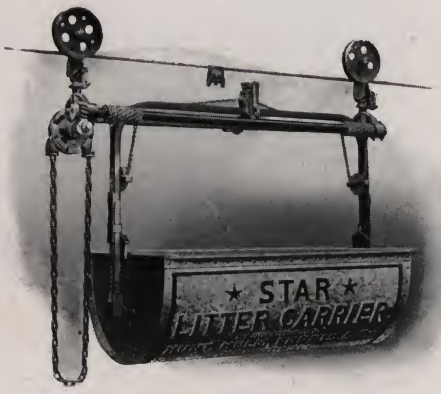


Fig. 445

The above is similar to the carrier on the preceding page except that the tub may be raised and lowered. This is accomplished by means of a chain passing over a drive wheel attached to the main shaft by a worm gear.

It embodies the distinctive features of all Star Carriers, such as roller bearings, large tracker wheels and rigid bail, which insures the correct working of the locks and trip and adds to the life of the tub by making it move firm. Dumps and returns to the barn automatically. Weight, 150 lbs.

With No. 2 Tub, 8-bushel, price.....$22.70

STAR CARRIER FOR ROD TRACK

Fig. 345

The above carrier has all the essential features which go to make up the individuality and superiority of the Star Line of carriers.

Large roller bearing tracker wheels. Spring keeper. Rigid bail of special channel steel. Tub locks at both ends, dumps automatically.

The tub is designed especially for this carrier. It is of heavy galvanized iron sides and wood ends an inch and one-half thick. Tub holds about five bushels. Weight, 70 lbs.

Price $14.00

ROD TRACK EQUIPMENT

The Rod Track we furnish with our carriers is size 0000, and is a high grade steel rod. It is cut to fit and looped.

Fig. 421

Price, per 100 feet.....$2.35
Weight, per 100 feet, 40 lbs.

Limited space prevents accurate description of our carrier equipment. The illustrations on this page give but a glimpse of two or three of its features.

Track is fastened with tension bolts at each end and an anchor rod, as shown below, holds the outside end firmly. This rod is fitted with a turnbuckle so that on each line of track there are three places where the tension may be adjusted.

Three things to remember in connection with the rod track carriers are that a firm and secure anchorage is absolutely necessary to its successful operation; the rod track works best in distances between 40 to 125 feet and it is only when a first class, firm anchorage can be secured that it is recommended for use for long distances.

Fig. 424

Price of tension bolts, each (7 lbs.)	$0.70
Price of anchor rod, each (10 lbs.)	1.35
Price of anchor rod with turnbuckle (20 lbs.)	2.70
Price, automatic stop and returning device (Weighed with carrier)	.80
Price, switches or curves, each (20 lbs.)	2.70

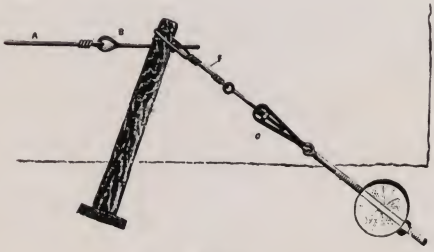


Fig. 353

Here's Why Harvester Hay Carriers Make Other Kinds "Old Style"

Up to the advent of the Harvester Hay Carrier, hay tools were much alike.

And the confidence of the public in Hunt, Helm, Ferris & Co. goods was what built our business on our standard Star Line Hay Tools—been making them for twenty-five years.

But feeling that conditions were changing, we worked out and perfected a line of Hay Carriers that embodied a number of new and real advantages over any hay tools ever before offered the trade.

Harvester Hay Carriers are new.

Their improvements make other kinds "old style." They lessen labor between the rack and loft by handling larger loads. They carry our full guarantee and represent all that any man could ask in a hay carrier.

Detailed descriptions of the different models in the following pages.

THE HARVESTER SLING HAY CARRIER

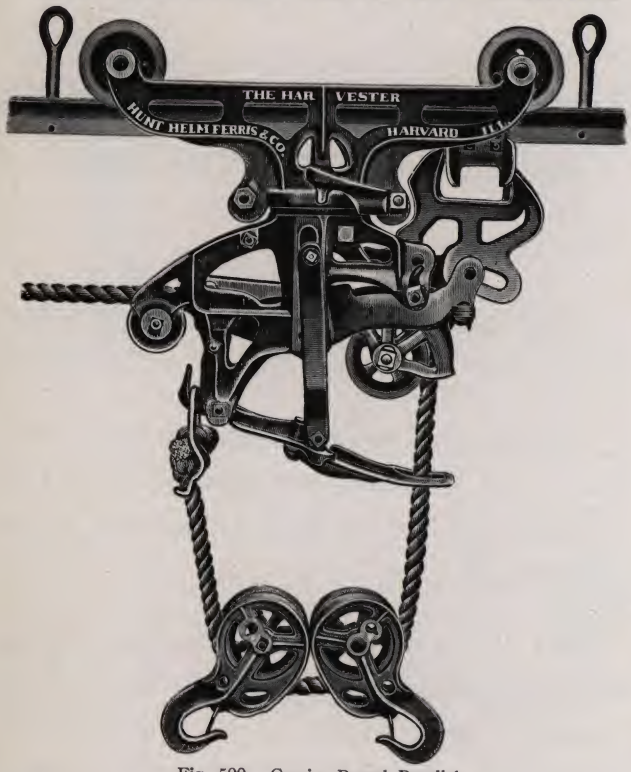


Fig. 500. Carrier Roped Parallel

NAME—Harvester, Fig. 500. Reversible Sling Carrier for Star Double Flange Steel Hay Carrier Track.

FRAME—Best grade malleable iron, fully reinforced, extra heavy and long wheel base so as to distribute the load over a greater portion of the track.

TRACKER WHEELS—Best gray iron, 3 inches in diameter at the tread, wide flange, hub drilled to take steel axle.

AXLE—This is a lathe-turned steel axle made by the most modern automatic machinery.

SHEAVES—Two in number, made of best gray iron, drilled to take steel axles. Frame of large sheave is hinged to rope gripping lever allowing sheave to adjust itself in line of draft, thus preventing rope chafing over edge of sheave.

SLING PULLEYS—Malleable frame of improved design. Extra wide flanges with rolled edges, preventing chafing of draft rope. Pulley hooks can be used with forks.

LOCK—Five-inch malleable iron rope grip so constructed that when pulleys strike tripping arm the lock slides forward and grips rope without chafing it and at the same time locks it securely. This operation automatically releases car from trip block. It is also arranged with a special trip rope by the use of which the load may be carried into the mow at any desired elevation.

THE HARVESTER SLING HAY CARRIER

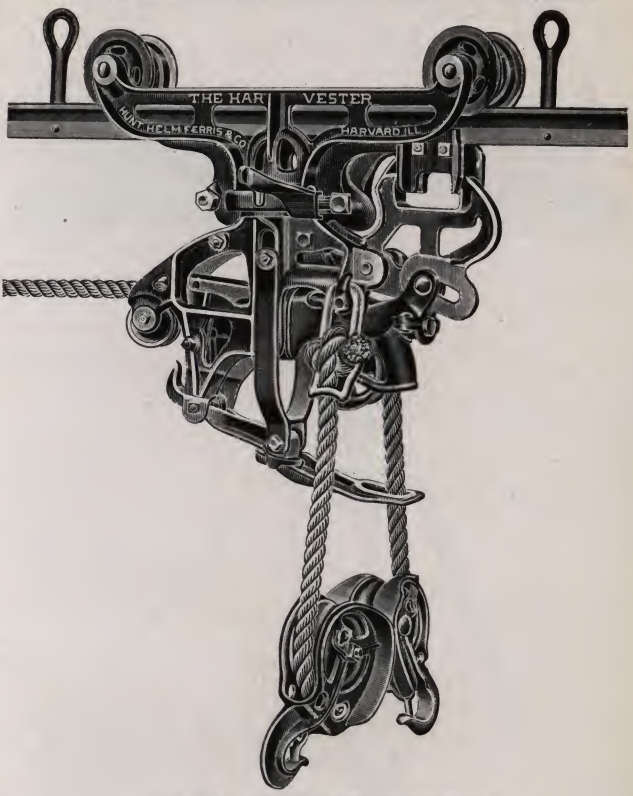


Fig. 500. Carrier Roped Right Angle

ROPE—This carrier is designed for use with rope only and we recommend ¾-inch or ⅞-inch pure manila as being the most serviceable. We furnish this same carrier with sheaves and sling pulleys made especially for cable draft rope.

DIRECTIONS—Full set of simple directions and illustrations sent with each carrier and mailed upon application.

WEIGHT—Harvester Carrier Fig. 500, for steel track, 49 lbs.

FINISH—Aluminum, trimmed in red.

In Fig. 500 we illustrate our very latest design in sling carrier. We show the carrier roped with the pulleys parallel to the carrier on the track. In the illustration on this page we show the same carrier roped so that the pulleys are at right angles with the carrier on the track and this change can be instantly made. While this carrier is designed for heavy work and to be used with slings, one or two forks can be used without changing the carrier or ropes in any manner. The carrier is shipped complete, perfectly adjusted and ready to set on the track. Full directions are attached to each carrier. We furnish this same carrier fitted with trucks and tracker wheels to be used in connection with wood track when desired. We also furnish this carrier fitted with legs, pulleys and with rope gripping device to take a ⅜-inch wire rope instead of manila rope.

List price **$12.00**

HARVESTER CROSS DRAFT SLING HAY CARRIER

Fig. 425

Above we illustrate the most successful cross draft hay carrier on the market. This is a superior carrier, made with the fewest parts. It holds the load at any elevation, holds it automatically without wearing the rope. It requires no trip block. We ship the carrier complete as illustrated above, and in addition, we include pulley bails and rope hitch of special design for the hoist and also for the shift rope. To each carrier we attach complete directions and instructions showing how carrier is roped.

The carrier is also made to be used in connection with wood track when desired.

List price $13.00

HARVESTER CROSS DRAFT SLING HAY CARRIER

NAME—Harvester Cross Draft Carrier, Fig. 425. This carrier is called "Cross Draft" from the fact that the draft rope runs from the carrier across the barn direct to the team, at a saving of considerable rope as compared with the old method and lessening the friction to a minimum.

ADJUSTMENT—This carrier is so constructed that it can be adjusted to fit other steel hay carrier tracks. This is done by turning the right and left hand tread bolt near center of carrier legs as shown in illustration opposite.

FRAME—Best grade malleable iron, fully reinforced. Extra heavy and long so as to distribute the load over a greater portion of the track. Wheel base, 16¾ inches center to center of tracker wheels.

TRACKER WHEELS—Best gray iron, 3 inches in diameter at the tread, wide flange, hub drilled to take steel axle.

AXLE—This is a lathe-turned steel axle made by the most modern automatic machinery.

SLING PULLEYS—Malleable frame of improved design. Extra wide flanges with rolled edges, preventing chafing of draft rope. Pulley hooks are large enough to be used in connection with any style or make of rope or chain slings, or in connection with forks.

AUTOMATIC ROPE GRIPPING DEVICE—This carrier is provided with a gripping device or lock having 4-inch gripping surface and curved to conform to circle of large sheave. When hoisting rope is slackened, locking device travels with sheave, thus clamping rope securely and with absolutely no chafing. The small rope attached to the lever as shown in illustration, when pulled, releases grip on draft rope and allows slings to return to load.

TRIP BLOCK—No trip block is used with this carrier, it being unnecessary as the draft rope pulls at right angles to the track.

ROPE—This carrier is designed for use with rope only and we recommend ¾-inch or ⅞-inch pure manila as being the most serviceable.

DIRECTIONS—Full set of directions and illustrations explaining the simple manner in which this carrier is roped and operated, is sent with each carrier and mailed upon application.

FINISH—Royal blue, gold bronze trim. Weight, Fig. 425 Cross Draft Carrier, each, 31 lbs. Fig. 478 for wood track, not illustrated, weight, each, 35 lbs.

HAY SLINGS

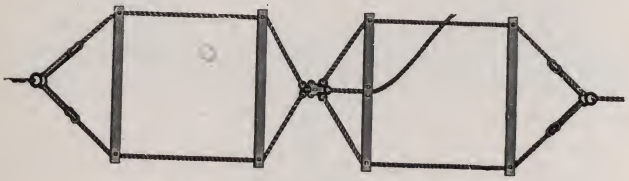


Fig. 55. O. K. Center Trip Sling

Fig. 55 represents our O. K. Center Trip Sling with 4-foot hardwood cross bars. We furnish this same sling, our No. 58, with 5-foot hardwood cross bars and 3 ropes. The ropes on all our slings are of half-inch loose twist of sufficient strength. Star slings have an adjustable take-up at either end so that they can be adjusted to suit length of hayrack.

List price, No. 55 Sling $3.20
List price, No. 58 Sling 4.00

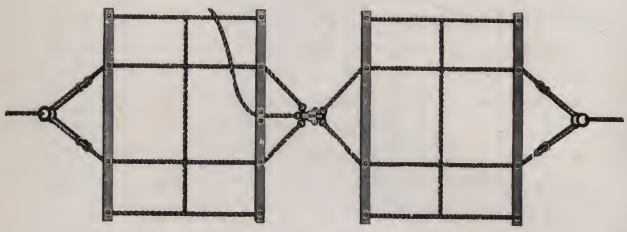


Fig. 56. Harvard Center Trip Sling

The Harvard Center Trip Sling, above illustrated, is extra strong, being made for heavy work. As this sling is specially roped it forms a bed or net sufficiently close to carry fine hay or grain. This sling is furnished with either 5-foot or 6-foot hardwood cross bars.

List price, No. 56 Sling $5.00

HAY SLINGS

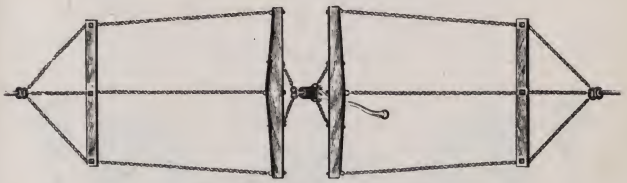


Fig. 395. Star Chain Sling

Above we illustrate a hay sling of special design, with extra heavy cross bars and heavy non-kinking galvanized chain in place of rope. The two center bars come closely together so that small bundles may be raised without becoming loosened or falling out of sling. We furnish this same style sling with four chains lengthwise and one chain across.

List price, Fig. 395 ..... $5.00

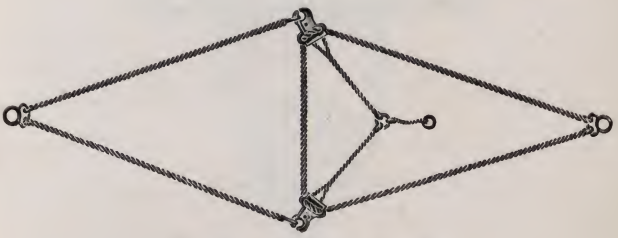


Fig. 480. Adjustable Rope Sling

Star center trip adjustable rope sling shown above is a radical improvement over the old style end trip rope sling. Where ropes are preferred this sling will be found to be most practical. Adjustable to any width. Furnished in one style only, which is 16 feet. List price, Fig. 480 ..... $2.40

Fig. 539. Junior Rope Sling

Fig. 549 illustrates the Junior Rope Sling, made with two ½-inch loose twist ropes that will not gnarl or kink. They have an adjustable takeup at one end so they can be shortened or lengthened, as desired. List price..$1.50

We also furnish, when desired, a Junior Sling, made with two chains instead of rope. Chains are galvanized, non-kinking and guaranteed to be strong enough for all purposes.

Price, Junior Chain Sling..... $2.50

THE HARVESTER FORK CARRIER, ROLLER BEARING

For Steel Track

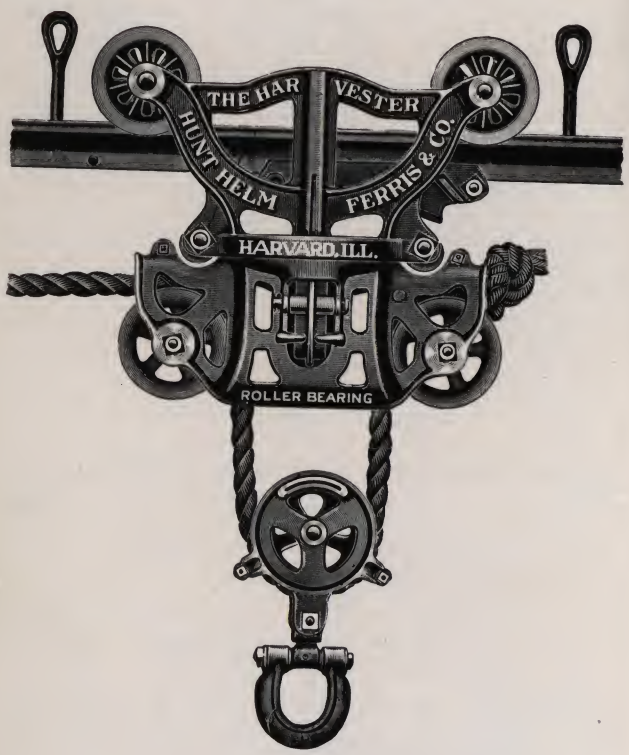


Fig. 502

NAME—Harvester, Fig. 502. Reversible Fork Carrier for Star Double Angle Steel Track.

FRAME—Best grade malleable iron, fully reinforced.

STAR NUT LOCK—Special Star feature used to prevent the frame bolts from working loose. This is an exclusive feature of all Harvester Carriers and insures absolute rigidity.

TRACKER WHEELS—Best gray iron, 3 inches in diameter at the tread, wide flange hub, drilled to take steel axle.

AXLE—This is a lathe-turned axle, made by the most modern automatic machinery.

Harvester Fork Carrier—Continued

SHEAVES—4 inches in diameter. Best grade gray iron, drilled to take steel axle.

SHEAVE BEARINGS—Eleven ¼-inch steel roller bearings, revolving on ⅝-inch steel shoulder pin.

FORK PULLEYS—Latest design, mounted in heavy frame, which is reinforced at locking portion. All fork pulleys are supplied with sister hooks for holding fork, including a universal joint between fork pulley and sister hook, allowing great freedom of movement. Fork pulleys are furnished with rope guards, making it impossible for rope to leave the sheave.

SLING PULLEYS—May be used in place of fork pulley, as illustrated, allowing use of slings when desired.

SISTER HOOKS—Special feature with all Star carriers. Constructed of two malleable iron castings, swiveling on steel bolt. By the use of these hooks a fork may be quickly detached. This sister hook is much superior to the ordinary hook and clevis.

LOCK—Improved type of gravity lock. No springs to rust out or break. This lock embodies the double grapple principle, permitting pulley to enter at any angle and holding it securely. Simple in construction and positive in action.

TRIP BLOCK—Made of best malleable iron of special design, with a depression on the under side bolting over a rivet head on the track, thus making it absolutely impossible to loosen.

ROPE—This carrier is designed for use with rope and we recommend ¾ or ⅞-inch pure manila as being the most serviceable.

FINISH—Aluminum, trimmed in red. Weight, 35 pounds.

This carrier is fitted with extra wide open mouth for engaging the fork pulley, which locks and holds the load no matter at what angle pulley enters the carrier. This carrier is also furnished for use with wood track as well as for cable track.

List price, Fig. 502 ..... $7.00

HARVESTER FORK HAY CARRIER

FOR STEEL TRACK

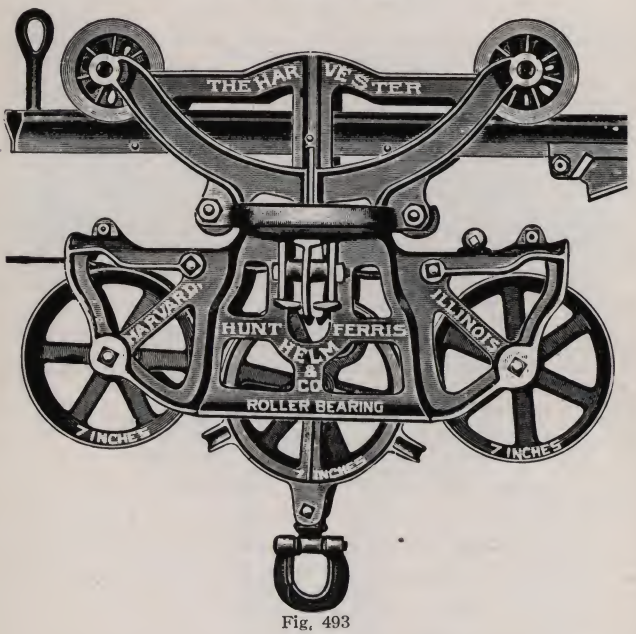


Fig. 493

Harvester Fork Hay Carrier, roller bearing, for steel track. Sheaves grooved for either rope or cable.

The above carrier is our very latest design in fork carriers, full roller bearing, 7-inch sheaves of great strength. A carrier that is designed for universal service. Large sheaves specially grooved for both rope and wire cable. We furnish this carrier for use in connection with wood track, also cable. For full description, see page 91.

Fig. 557 illustrates improved cable clamp, shipped with carrier without extra charge. By the use of this clamp the cable is attached quickly and clamps fit into socket of carrier frame, allowing same to turn, thus taking out all twist of the wire cable.

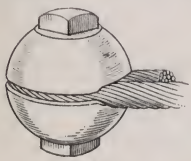


Fig. 557

Fig. 556 illustrates a cross section of 7-inch roller bearing sheave to be used in the above carriers.

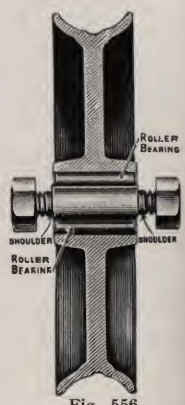


Fig. 556

THE HARVESTER HAY CARRIER

ROLLER BEARING

NAME—Harvester, Fig. 493. Reversible Fork Carrier for Star Double Flange Steel Hay Carrier Track. Full roller bearing sheaves.

FRAME—Best grade malleable iron, fully reinforced.

STAR NUT LOCK—Special Star feature, used to prevent the frame bolts from working loose. This is an exclusive feature of all Harvester carriers and insures absolute rigidity.

WHEEL BASE—15½ inches, center to center.

TRACKER WHEELS—Best gray iron, 3 inches in diameter at the tread, hub drilled to take special steel axle.

AXLE—This is a lathe-turned steel axle, made by the most modern automatic machinery.

SHEAVES—7 inches in diameter, best gray iron, drilled to take steel axle. The three large sheaves on this carrier are grooved for ⅞-inch rope or ⅜-inch wire cable, as desired,

SHEAVE BEARINGS—Eleven ¼-inch steel roller bearings revolving on ⅝-inch steel shoulder pin.

FORK PULLEYS—Improved design, fitted with 7-inch roller bearing sheave and sister hook.

SLING PULLEYS—May be used in place of fork pulley, as illustrated, thus allowing use of slings when desired.

SISTER HOOK—Special feature with all Star Carriers. Constructed of two malleable iron castings, swiveling on steel bolt. By the use of this hook, the fork may be quickly detached. Much superior to the ordinary hook and clevis.

LOCK—Improved type of gravity lock. No springs to rust out or break. This lock embraces the double grapple principle, permitting pulley to enter at any angle and holding it securely. Simple in construction and positive in action.

TRIP-BLOCK—Made of best malleable iron, of special design, with a depression on the under side bolting over a rivet head on the track, thus making it absolutely impossible to loosen.

ROPE—This carrier is fitted with sheaves so designed that it may be used with either ¾-inch or ⅞-inch manila rope or ⅜-inch wire cable and without any changing of the carrier.

DIRECTIONS—A full and illustrated set of directions with each carrier or mailed upon application.

FINISH—Aluminum, trimmed in red.

WEIGHT—Weight, each, 48 lbs.

List price, Fig. 493.....$9.00

STAR DOUBLE FLANGE STEEL HAY CARRIER TRACK

FIG. 142 illustrates a section of Star Double Flange Steel Hay Carrier Track. The tests to which this track has been subjected during the past fifteen years in many thousands of barns throughout the United States gives us the right to claim a superiority over any track on the market.

MATERIAL—Star Steel Hay Carrier Track is made of high carbon steel of the same grade used in the manufacture of railroad rails.

CONSTRUCTION—Star Steel Hay Carrier Track is as simple in construction as it is strong and durable. It is really two tracks in one—the two special rolled steel bars being securely joined with rivets. These rivets are only eight inches apart, which makes the track rigid, therefore it will not bend like an open track.

STRENGTH—The strength of any track is in its thickness rather than its width. It is a well known fact that any material set on edge will support a heavier load without bending than if laid flat. On this principle we have constructed Star Hay Carrier Track. It is guaranteed to be as strong at the splice as at any other place. It will not buckle, bend nor spring. By actual test we have found Star Steel Hay Carrier Track able to sustain nearly twice as heavy a load as any other hay carrier track manufactured.

HANGERS—Star Track Hangers slide lengthwise of track, thus adjusting to any rafter bracket. Hangers may be put in or taken out if necessary without disturbing the track.

SPLICE—In Fig. 143 we show plainly the construction of a splice, consisting of three pieces of malleable iron, one section inside of track and two sections outside, and so locked that it cannot become loosened. No drilling nor punching is necessary to fit spliced blocks as they are shipped complete with bolts and are furnished no charge.

TRIP BLOCK—The Trip Block used with Star Hay Carrier Track fits over the head of a rivet on the track wherever desired. It cannot possibly jar loose or slide.

INSTALLATION—One of the most desirable features of Star Hay Carrier Track is the ease with which it is installed, requiring a wrench only to bolt the splice in place. The track is shipped complete, ready to install.

STAR DOUBLE FLANGE STEEL HAY CARRIER TRACK AND FIXTURES

Fig. 142

The above illustration shows a section of our Star Double Flange Steel Hay Carrier Track. Made in 6, 8 and 10-foot lengths. Per foot, $0.20.

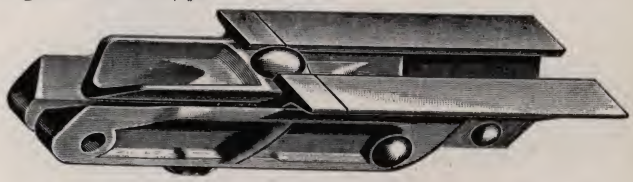


Fig. 143

The above illustration shows construction of splice block and method of holding track together.

Fig. 148. Hanger for Double Flange Steel Track.

Per doz., $1.40

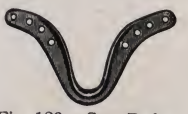


Fig. 126. Star Rafter Bracket

Per doz., $0.60

Fig. 145. Adjustable Hanger and Rafter Bracket for Double Flange Steel Track.

Per doz., $2.00

Fig. 146. Combined End Hanger and Stop for Double Flange Steel Track.

Price per doz. $1.40

To keep the carrier from running off the end of the track.

Fig. 72. Track Rod.

To be used with combined end hanger and stop where it is desired to prevent the track from working endwise.

List, each $0.30

Weight, rafter brackets, per doz., 4 lbs. 5 oz.

Weight, double flange hangers, per doz. 4 lbs.

WOOD TRACK HANGERS AND OTHER FIXTURES

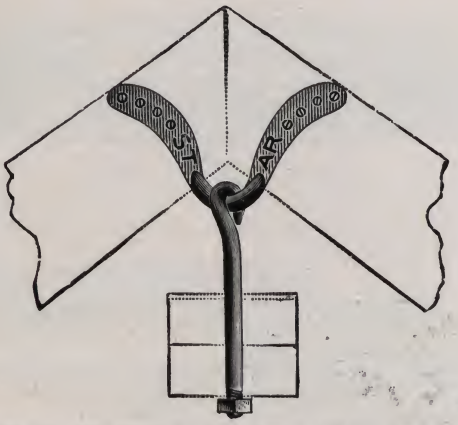


Fig. 79. Star Wood Track Hanger and Rafter Bracket

By the use of this hanger the track is hung directly in the center of the peak and has the full strength of both rafters.

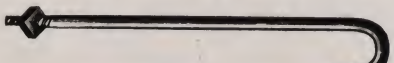


Fig. 84. Track Hanger Hook

Made in three sizes, 12, 14 and 16-inch. Price, per doz., $1.10, $1.20, $1.30.

Fig. 131. Wood Track Hanger.

10-inch. Per doz., $1.00.

Fig. 87. Ridge-Pole Hanger

Fig. 85. Floor Hook

Made in two sizes: $\frac{5}{8}$ and $\frac{3}{4}$-inch

Price, each, $0.10, $0.12.

Made of the best malleable iron, of proper size to be used on ridge-pole 2x6 or 2x8. By driving a nail in each slot it is made secure enough to hold any track. Per doz., $1.50, list.

Fig. 86. Swivel Rope Hitch and Hook

One of the most handy and useful articles in a hay tool outfit. No hard knots to untie, no wasting of rope by cutting knots open. Twist in the rope is removed by the swivel. List, per doz., $3.20.

FIXTURES FOR SUPPORTING STEEL HAY CARRIER TRACK AT END OF BARN

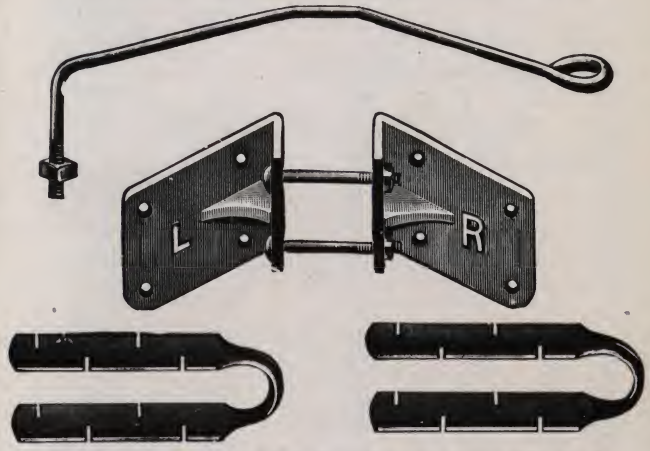


Fig. 73. Cut Showing a Set of Fixtures for Supporting Steel Track at the End of Barn.

List price for set.....$2.00

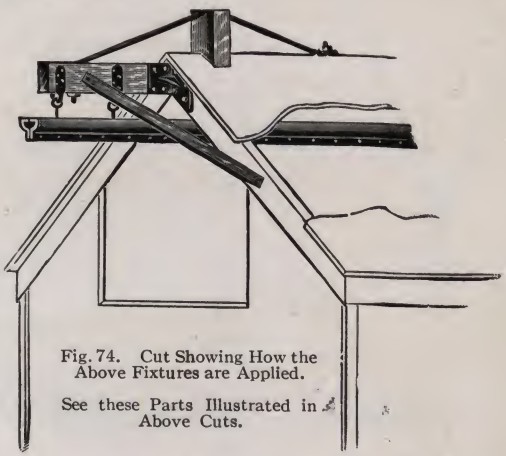


Fig. 74. Cut Showing How the Above Fixtures are Applied.

See these Parts Illustrated in Above Cuts.

Many ways have been devised for supporting steel track at the end of barn, nearly every carpenter having a way of his own which has not always proved to be the best. It is important that the track at end of barn should be well supported because the heavy pull is at this place, and a little defect in supporting the track will cause a great deal of trouble. We show in the above cut a means of doing this, which we believe to be as good as any other, if not the best way. We are prepared to furnish the above fixtures complete and ready for use to dealers at a reasonable price.

A set consists of two heavy angle shape castings with bolts; one bar, ½-inch round iron, 8 feet long, with eye at one end and nut at the other; two malleable ridge pole hangers.

CUTS SHOWING HOW TO SUPPORT STEEL AND WOOD HAY CARRIER TRACKS AT END OF BARN

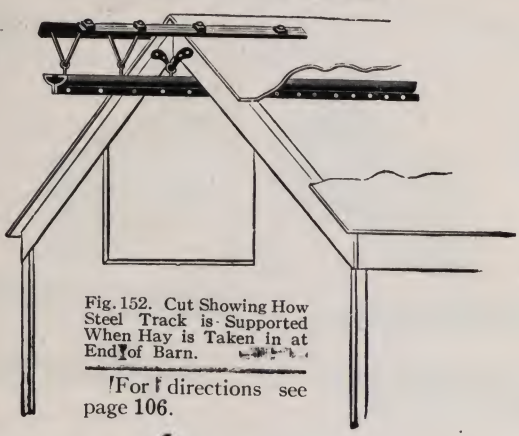


Fig. 152. Cut Showing How Steel Track is Supported When Hay is Taken in at End of Barn.

For directions see page 106.

Fig. 88. V End Hanger for Steel Track

This hanger is used to support the track when the hay is taken in at end of barn, as shown in Fig. 152.

Weight, V-End Hangers, each, 1 lb. 5 oz. List price, each, $0.50.

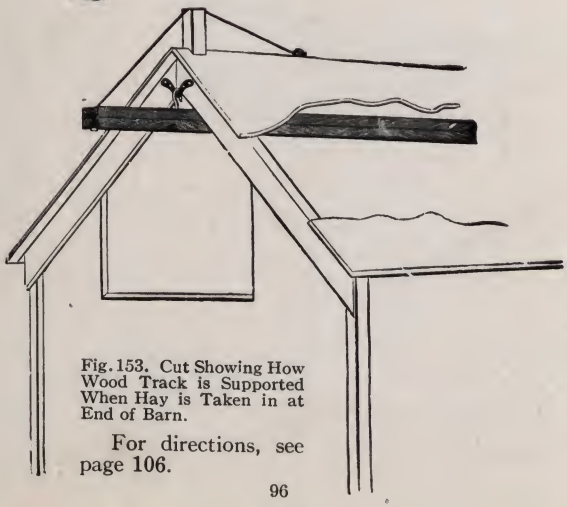


Fig. 153. Cut Showing How Wood Track is Supported When Hay is Taken in at End of Barn.

For directions, see page 106.

HAY FORKS

Fig. 94. Nellis Hay Fork

Weight, Nellis Fork, each 11 lbs.

Each, $3.00

Fig. 95. Short Head Double Harpoon Fork

Made of steel. Length of tines under the cross-bar, 25 inches.

Weight D. H. Fork, No. 95, each 16½ lbs. List price, $1.60.

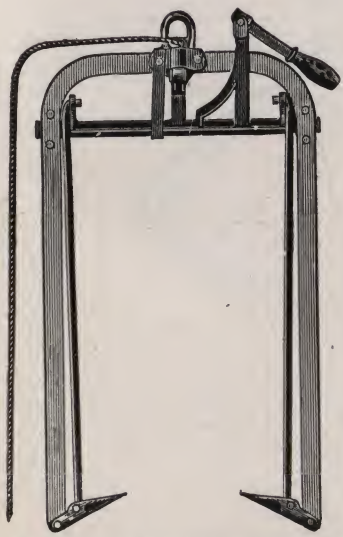


Fig. 96. Lock-Lever Double Harpoon Fork

Fig. 97 same as Fig. 95, except that tines are 31 in. long. Price, each, $2.00.

Made of special spring steel, 1¼x⅜, with malleable lever and barbs. It has large capacity owing to the cross-bar being placed near top of fork. Length under the cross-bar, 30 inches. The special feature is that it locks open as well as closed.

Weight, L. L. Fork, No. 96, each, 25 lbs.

List price $3.75

HAY FORKS — GRAPPLE

4 and 6 Tine

The Automatic Safety Grapple Fork, without center tine, especially adapted for the quick handling of loose or baled hay, fodder, etc. Constructed of high carbon spring steel.

Fig. 559

Fig. 559 shows 4-tine fork open and ready to set in hay. The pull on the trip rope releases load and the fork closes and locks automatically as shown in Fig. 558, eliminating the danger from an open fork descending to the load over the operator.

Weight, Fig. 559, 4-tine fork, each, 40 lbs. List price, $7.00.

Fig. 558

Fig. 558 shows 6-tine grapple fork closed after it has released the load and comes back to the wagon, ready for the operator to pick it up and place it in the hay as desired.

These forks trip easily from any direction, are double braced, very strong and guaranteed.

Weight, Fig. 558, 6-tine fork, each, 45 lbs. List price, $8.50.

HAY FORKS, GRAPPLE WITH CENTER TINE

Fig. 99

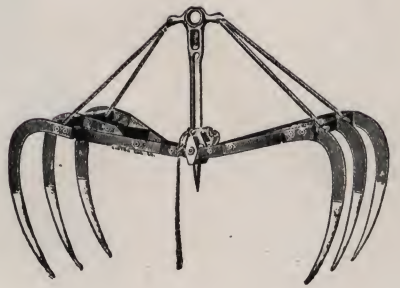


Fig. 100

These forks are made both 4 and 6-tine, from the best quality of spring steel and nicely finished. The trip is simple and sure, and not liable to get out of order. Fig. 100 shows the fork set for inserting into the hay. Fig. 99 shows position when loaded.

Weight, Fig. 99, 4-tine fork, each, 38 lbs. List Price, $7.00
Weight, Fig. 100, 6-tine fork, each, 47 lbs. List Price, $8.50

HAY FORK PULLEYS

Malleable Frame Knot-Passing Pulleys

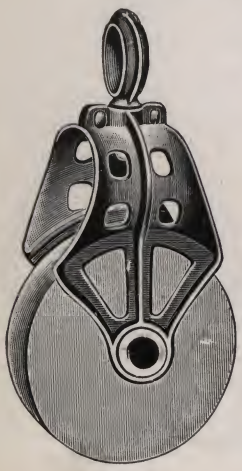


Fig. 103

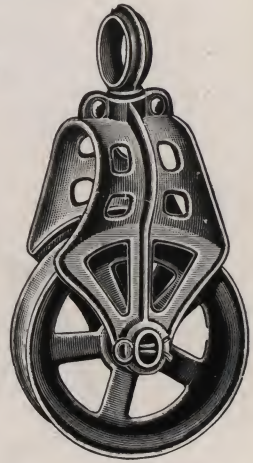


Fig. 104

Fig. 103 Knot Passing Pulley has 6-inch hard maple sheave, large hollow pin.
Weight, doz., 36½ lbs. List price, each, $0.40.
Fig. 104 shows the same frame with 6-inch cast iron sheave.
Weight, doz., 48 lbs. List price, each, $0.45.

Steel Frame Knot-Passing Pulleys

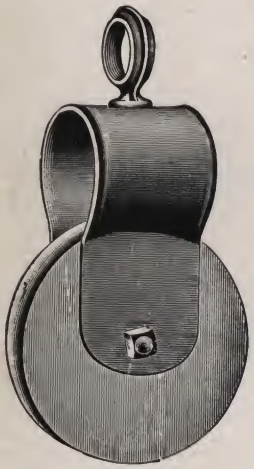


Fig. 105

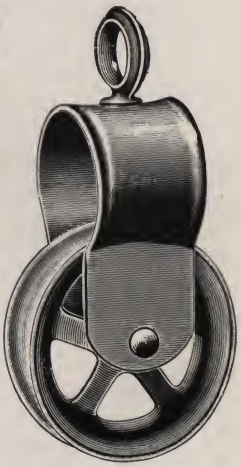


Fig. 106

Fig. 105 Steel Frame Knot Passing Pulley has 6-inch hard maple sheave, which revolves on large bushing.
Weight, dozen, 36½ lbs. Price, each, $0.35.
Fig. 106 represents same frame with 6-inch cast iron sheave. The sheaves are interchangeable.
Weight, doz., 50 lbs. Price, each, $0.35.

HAY FORK PULLEYS

Cast Frame Pulleys Hollow Pin

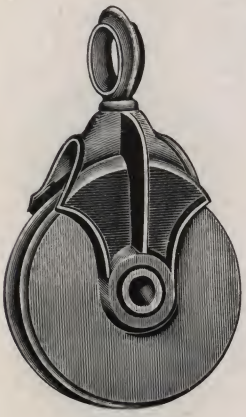


Fig. 101

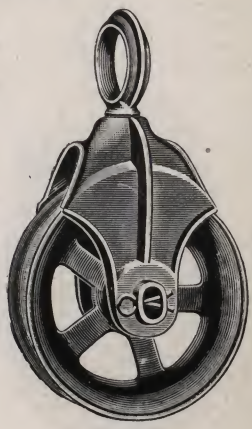


Fig. 102

Fig. 101 Cast Frame Pulley has 6-inch hard maple sheave, revolving on large hollow pin.

Weight, doz., 38 lbs. Price, each, $0.30.

Fig. 102 represents the same frame with 6-inch iron sheave. Sheaves are interchangeable.

Weight, doz., 48 lbs. Price, each, $0.30.

Star Pulley

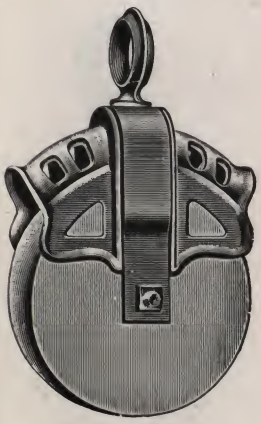


Fig. 113

Big Star Pulley

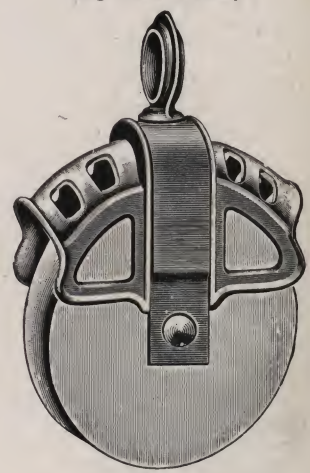


Fig. 114

Fig. 113. Star Pulley. With steel yoke, malleable swivel eye, large bushing and hard maple 6-inch sheave. Frame constructed to prevent chafing of rope.

Weight, dozen, 41 lbs. Price, each, $0.35.

Fig. 114. Big Star Pulley. It has hard maple sheave 7 inches in diameter. The frame is malleable iron, extra strong and heavy, with steel yoke, malleable swivel eye, and large bushing. Frame constructed to prevent chafing of rope.

Weight, dozen, 54 lbs. Price, each, $0.65.

HAY FORK PULLEYS

Peerless Pulley Knot-Passing

Fig. 80

Malleable Frame Pulley Knot-Passing

Fig. 48

Fig. 80. Knot-Passing Peerless Pulley. It has a hard maple sheave, 7 inches in diameter. The frame is extra strong and heavy. Has malleable swivel eye and large bushing. Frame constructed to prevent chafing of rope. Price, each, $0.80.

Fig. 48 illustrates our new malleable frame Knot-Passing Pulley, with large hollow pin. It has a hard maple sheave 6 inches in diameter. Frame is made of malleable iron, extra strong and heavy. Has malleable swivel eye. Frame constructed to prevent chafing of rope. Price, each, $0.45.

Malleable Frame Pulley. Hollow Pin

Fig. 127

Fig. 125

Fig. 127 illustrates our new Malleable Frame Hollow Pin Pulley. Frame constructed to prevent chafing of rope. Malleable swivel eye, 6-inch hard maple sheave. We also furnish this pulley with 6-inch iron sheave, Fig. 128. Price, each, $0.40.

Fig. 125 illustrates our new Malleable Frame Pulley, with roller bearings. Has malleable swivel eye and 6-inch iron sheave. Made for the very best trade. Price, each, $0.80.

HAY FORK PULLEYS

Steel Frame Pulleys

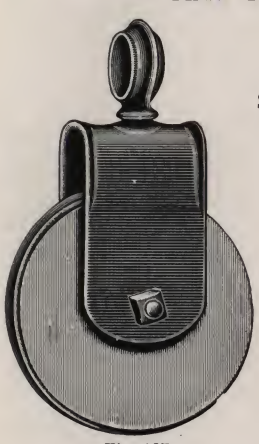


Fig. 107

Fig. 108

Fig. 107. Plain Steel Frame Pulley. The sheave is made of hard maple; is 6 inches in diameter, revolving on large bushing.
Weight, dozen, 27½ lbs. Price, each, $0.30.

Fig. 108. Same frame with 6-inch cast iron sheave. Sheaves interchangeable.
Weight, dozen, 39 lbs. Price, each, $0.30.

Fig. 108½ represents same pulley as Fig. 108 except that the sheave is 5½ inches in diameter instead of 6 inches.
Weight, dozen, 35 lbs. Price, each, $0.30.

All Iron Pulley

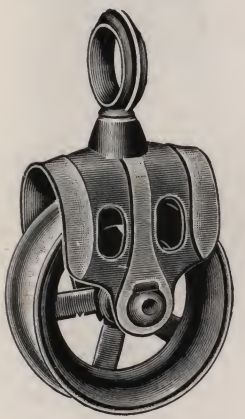


Fig. 109

Floor Pulley

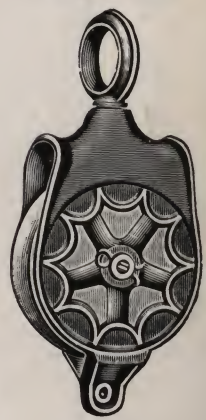


Fig. 110

Fig. 109. Our all iron pulley. Cast iron frame, with sheave 5½ inches in diameter. Has swivel eye.
Weight, dozen, 40 lbs. Price, each, $0.30.

Fig. 110. Frame thoroughly protects the sheave. Sheave is made of hard maple.
Weight, dozen, 39 lbs. Price, each, $0.40.

HAY FORK PULLEYS

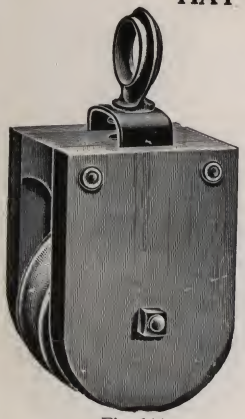


Fig. 111

Wood Frame Pulleys Reed Pattern

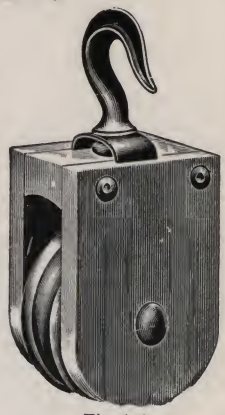


Fig. 112

Fig. 111. Our Wood Frame Pulley. The frame and sheave are hard maple. Sheave revolves on large bushing.
Weight, dozen, 34 lbs. Price, each, $0.35.
Fig. 112 represents the same construction, except that a swivel hook is used in place of malleable eye.
Weight, dozen, 36 lbs. Price, each, $0.35.

Fig. 43

Fig. 44

Fig. 43 represents our Steel Frame Cable Pulley which is fitted with 7-inch iron sheave adapted for ⅜ or ½-inch cable. Frame made of high carbon steel. We use a very heavy machine bolt to hold sheave in place, making an extra strong pulley. We also furnish this pulley of the same construction but fitted with roller-bearing sheave.
Weight, Steel Frame Fig. 43, per dozen, 90 lbs. Each, $1.25.
Fig. 44 illustrates our Wood Frame Cable Pulley. Each, $2.00.
This pulley is fitted with 7-inch iron sheave. Heavy hard-wood frame. This is a very substantial pulley and manufactured for heavy work.
Weight, Wood Frame Fig. 44, per dozen, 125 lbs.

HAY FORK PULLEYS

Fig. 554

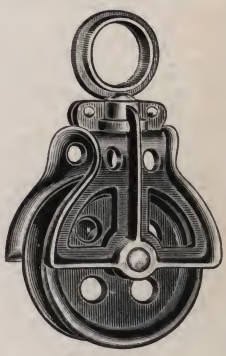


Fig. 155

Fig. 554 shows Giant Star Wood Frame Pulley, hard maple sheaves, 10 inches in diameter. The sheave of this pulley being extra large and turning on bushing 1⅛ inches in diameter makes it of very light draft. The bushing fits into the bottom of the steel yoke to which is attached a large wrought iron pulley hook.

The frame is wood, made of perfect stock bolted together and braced in such a manner as to insure a pulley of great strength.

Price, each $1.50

Fig. 155 is designed especially to use with shift rope in connection with No. 425 Cross Draft Carrier, page 92.

Price, each $0.40

Star Pulley Changer for Wood or Steel Track

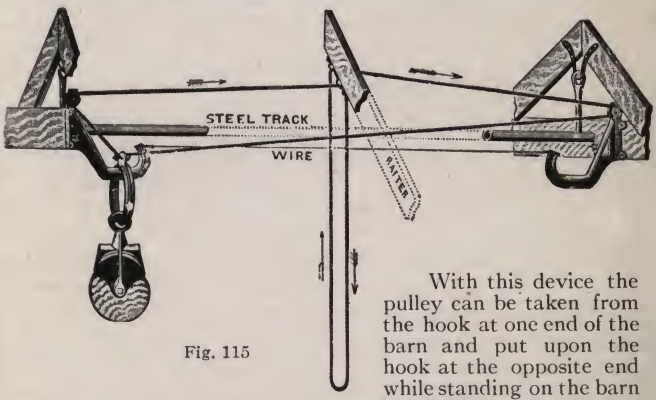


Fig. 115

With this device the pulley can be taken from the hook at one end of the barn and put upon the hook at the opposite end while standing on the barn floor. A complete change can be made in a 60-foot barn in five minutes. It will work with any of our swivel carriers for wood or steel track. Why climb up in the barn to change the pulley, when it can be done from the floor.

Weight, per set, 7½ lbs. Price of set $2.00

DIRECTIONS FOR PUTTING UP HAY TOOL OUTFITS

Directions for Putting Up Wood Track at End of Barn

Take a bar of ½-inch round iron and make an eye at one end and thread and nut at the other end. Bend the rod over a standard (page 96) and bolt the other end through the roof of the barn.

Directions for Putting Up Steel Track at End of Barn

When hay is taken in at end of barn, fasten a piece of 2 x 6 across the rafters near the end of barn to prevent the track from working endwise, and let the other end extend out of barn. Bolt the trip block to the track over the rivet, about two feet outside of the end of the barn. Bolt two pieces 4 x 4 to the roof as shown (page 94), extending same about three feet from the end rafter. Place one V-shaped end hanger (Fig. 88) at the end of these pieces and the other half-way between that and the end of barn.

Directions for Putting Up Wood Track

Put hangers on four rafters over the driveway and about six feet apart for the balance. Nail rafter irons on with clinch nails. See that the track is the proper depth where trip block goes on to properly operate the locks. The trip block may need blocking down from the track, or setting up into the track, according to the depth of track used. See that the nuts are all let in on the under side of track. Use ¾-inch rope, and boil and stretch it to make it soft and pliable.

Directions for Putting Up Star Steel Track

Slip rafter brackets through hangers and nail to rafters in each end of barn and one in the center with clinch nails. Fasten a string to rafter brackets in end of barn and pass it over the one in the center; draw up tight and fasten to the one in the other end of the barn. This will be a gauge to get the hangers all even and in line. Put hangers on to each pair of rafters through the barn. Elevate the track, one section at a time, and slide it on the hangers, then splice the track and be sure that the nuts are drawn up tight on the three bolts. Fasten a piece of 2x6 across the rafters at each end of the track, to prevent the track from working endwise. If a pulley changer is to be used, bolt hook No. T-5 to this 2x6 three or four inches to one side of track; but if not, use a floor hook in place of T-5 to hold the pulley. See that the bolts in the trip block are drawn up tight. The trip block can be put on at any place where there is a rivet.

HARVESTER HAY CARRIER OUTFITS

Materials Required for Barns of Various Lengths

FOR STEEL TRACK CARRIERS

For 40-foot Barns

One carrier, 36 feet of track, 19 hangers, 19 rafter brackets, 2 lbs. of bracket nails, 5 pulleys, 1 fork, 6 floor hooks.

For 50-foot Barns

One carrier, 48 feet of track, 25 hangers, 25 rafter brackets, 2½ lbs. of bracket nails, 5 pulleys, 6 floor hooks, 1 fork.

For 60-foot Barns

One carrier, 60 feet of track, 31 hangers, 31 rafter brackets, 3 lbs. of bracket nails, 5 pulleys, 1 fork, 6 floor hooks.

For 70-foot Barns

One carrier, 66 feet of track, 34 hangers, 34 rafter brackets, 3½ lbs. of bracket nails, 5 pulleys, 1 fork, 6 floor hooks.

For 80-foot Barns

One carrier, 78 feet of track, 40 hangers, 40 rafter brackets, 4 lbs. of bracket nails, 5 pulleys, 1 fork, 6 floor hooks.

FOR WOOD TRACK CARRIERS

For 40-foot Barns

One carrier, 21 hanging hooks, 21 rafter brackets, 2 lbs. of bracket nails, 5 pulleys, 1 fork, 6 floor hooks.

For 50-foot Barns

One carrier, 26 hanging hooks, 26 rafter brackets, 2½ lbs. of bracket nails, 5 pulleys, 1 fork, 6 floor hooks.

For 60-foot Barns

One carrier, 31 hanging hooks, 31 rafter brackets, 3 lbs. of bracket nails, 5 pulleys, 1 fork, 6 floor hooks.

For 70-foot Barns

One carrier, 36 hanging hooks, 36 rafters brackets, 3½ lbs. of bracket nails, 5 pulleys, 1 fork, 6 floor hooks.

For 80-foot Barns

One carrier, 41 hanging hooks, 41 rafter brackets, 4 lbs. of bracket nails, 5 pulleys, 1 fork, 6 floor hooks.

THE CANNON BALL BARN DOOR HANGER

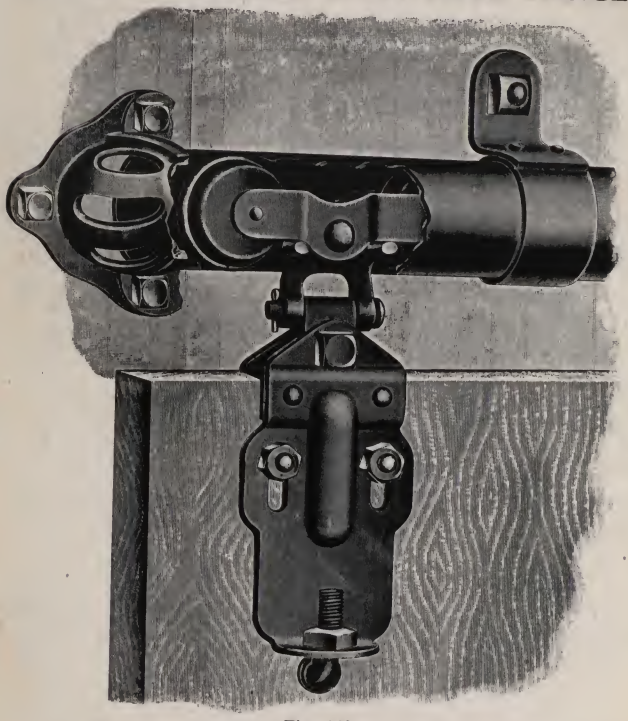


Fig. 440

Fig. 440 illustrates the Cannon Ball Barn Door Hanger with lateral and vertical adjustment. This hanger stands today as the most popular and largest selling hanger on the market and there is hardly a dealer or contractor but that is familiar with its many points of superiority. The pendant can be instantly adjusted either laterally, vertically or both ways, with the use of an ordinary wrench, so the door can be set nearer or farther away from the building, or can be raised or lowered as desired.

The larger wheels are constructed of hollow steel balls, are flexible, indestructible, frictionless and roller bearing.

List price of Fig. 440 Hangers, per pair $2.00
List price, Track, per foot 20
List price, Brackets, per doz. 1.50

Fig. 387

Fig. 387 illustrates a section of Cannon Ball Rail with center and end bracket. This track is made from No. 14 gauge steel, specially formed and slotted on the under side to take the hanger frame.

Cannon Ball Rail is made in 3 ft. sections only, insuring great strength and ease of installation. One man can install a Cannon Ball Rail Track while ordinary rail in long sections

requires the services of two men. The sections are joined together by No. 12 gauge steel splices to which are attached heavy brackets for supporting the track to the side of the building.

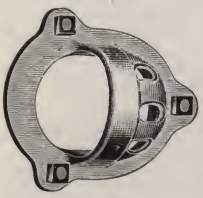


Fig. 474

Fig. 474 illustrates combination end bracket and track support for Cannon Ball Track. This bracket completely closes the end of the track and holds it absolutely rigid.

Fig. 385 shows an end view of Cannon Ball Rail and Hanger. Note the extra wide tread of the Cannon Ball Wheels. The peculiar shape of the inner side of the track is such that no dirt or dust can lodge therein. Cannon Ball track is the only self-cleaning track on the market. It is completely closed, water-proof and bird-proof.

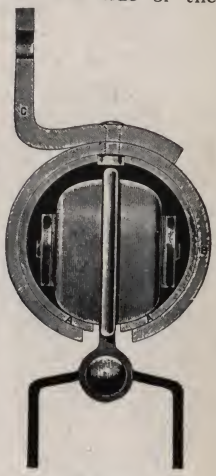


Fig. 385

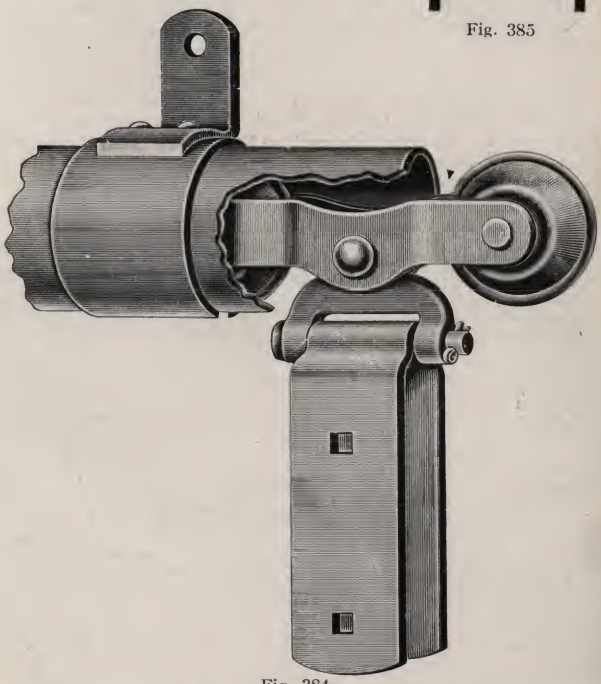


Fig. 384

Fig. 384 illustrates the Cannon Ball hanger of the non-adjustable type, the only difference between this hanger and the Cannon Ball Adjustable No. 440 is in the strap of the hanger.

Simple directions are enclosed with each pair of hangers.

List price, per pair.....$1.85

20TH CENTURY ROUND TRACK HANGER

Wherever a round track hanger is wanted, the 20th Century is the one selected. The 20th Century owes its popularity to its form of construction and its use in connection with a track made of steel completely closed and in 2 ft. lengths only.

Fig. 28

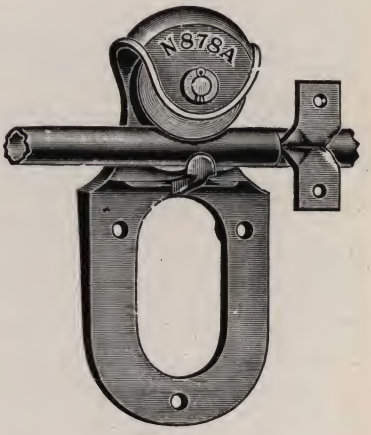


Fig. 35

Figs. 28, 29 and 35 above illustrate the 20th Century Hanger in different positions. The frame and hood of the hanger are all in one piece—a great argument for stability, strength and long service. No door is too large or heavy for the 20th Century. The wheels are deeply grooved and run on hardened roller bearings. A projecting lip on the open side of the hanger prevents jumping the track. List price, per pair.... $1.60

Fig. 29

Fig. 42

Fig. 42 illustrates malleable end bracket and track support.

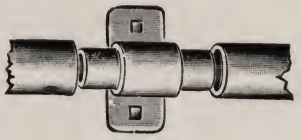


Fig. 82

Track, per foot $0.14

Fig. 82 illustrates method of adjusting bracket to the track. The splice is of the same diameter as the rail and causes no jar whatever as the hanger passes over the splice. 20th Century rail is guaranteed to be as strong at the splice as any other place and stiff enough to sustain the heaviest door.

Fig. 30

Fig. No. 30 illustrates a section of 20th Century barn door rail. 20th Century rail is manufactured in 2 ft. sections only on account of which it has decided advantages over ordinary round track in longer sections. 20th Century rail can be put up with one-half the labor required to put up ordinary rail. One man can do the work instead of two. Only 2 ft. section and one bracket goes up at a time. You do not have to balance a 10 ft. section in the air. The bracket turns on the splice so that the rail cannot warp. Any kind of door can be fitted with the necessary length of track, it being unnecessary for a carpenter to take out different lengths of rail for different size doors. As the rail is closed instead of open, no water can get in to rust it, as is the case with other round rails.

Fig. 49

Fig. 49 illustrates a sectional view of end track bracket.

Fig. 154

Figure 154 illustrates the manner in which 20th Century hangers are attached to the door. Complete directions with every pair of hangers, making it an easy matter for one man to install the hangers and track complete.

FLEXO BARN DOOR HANGER

Fig. 397. Front View

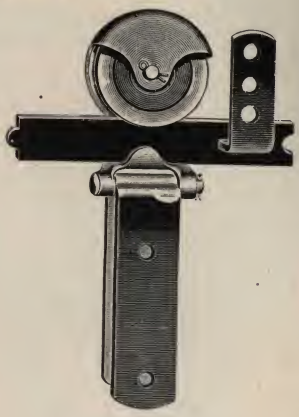


Fig. 398. Back View

Figs. 397, 398 and 399 illustrate the best hinge door hanger made.

The Flexo hanger has a malleable hood which entirely protects the wheel. It is flexible and hinged to the door so that it can be raised at the bottom as desired and brings the center of the door directly under the hanger. The hanger is neat and compact in design. Owing to the projecting lip on the under side of the hanger as shown in Fig. 398, it is impossible for the hanger to leave the track. The Flexo hanger is provided with roller bearings and with double steel door strap with removable steel pin. Price, per pair $1.10

Fig. 399. Edge View

In Fig. 160 we illustrate the Flexo rail used in connection with the Flexo Barn Door Hanger. This track is of heavy special high carbon steel, $\frac{3}{16}$ x $1\frac{1}{4}$ inches, supported by rigid bracket with square shoulder mortised through the track every 17 inches, thus making a very substantial fastening and adding materially to the stiffness of the track. It has more than twice the strength of ordinary track. Price, per foot $0.08

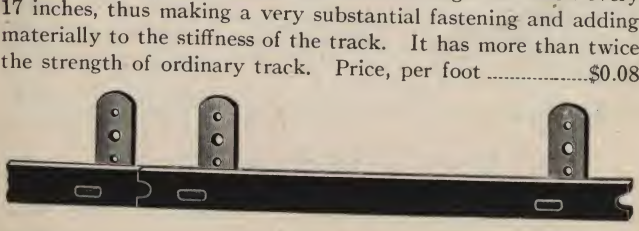


Fig. 160. Flexo Rail